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ASSESSING THE POTENTIAL IMPACT OF LOWERING THE LEGAL BLOOD ALCOHOL LIMIT TO 50 MG% IN CANADA

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17. Abstract

The purpose of this review is to estimate the potential impacts of lowering the legal limit in Canada to 50 mg%. Four lines of evidence which are most relevant to estimating the effects of a reduction of the legal BAC limit to 50 mg% are considered. The first is research on the effects of alcohol on the skills and abilities necessary to drive an automobile (i.e., experimental studies). The second line of evidence is epidemiological research on the BACs found among various groups of drivers and the risk of collision involvement at various BACs. The third line of evidence is research on the impact of lowering the legal BAC in other countries and jurisdictions. Lastly, other possible impacts of lowering the legal BAC are noted, such as public acceptance, police discretion and possible judicial and penal outcomes. A large number of experimental studies have been conducted on the impact of low doses of alcohol on driving-related skills, and it is clear that the impairing effects of alcohol on the skills necessary to drive safely begin at low BACs and increase with increasing BACs. Epidemiological research has allowed identification of the impact of alcohol consumption on the risk of collision involvement. The studies reviewed suggest that, overall, individuals in the 50 to 80 mg% range are one and a half to ten times more likely to be involved in a collision than a person who had not been drinking. Many evaluations of the impact of introducing or lowering a legal BAC limit have been reported. These studies suggest that the maximum impact of a 50 mg% BAC limit could be a 6% to 18% reduction in total motor vehicle fatalities; in other words an estimated decrease of between 185 and 555 fatalities per year in Canada.

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EXECUTIVE SUMMARY

Although important decreases have been achieved in levels of drinking-driving and alcohol-related collisions in Canada, research reveals a continuing and high level of social, personal and health costs resulting from drunk driving. Any successful new initiative has the potential to create substantial savings in costs and human suffering.

Almost since Canada's per se law was introduced in 1969, making it an offence under the Criminal Code to drive with a Blood Alcohol Concentration (BAC) of 80 mg% or more, recommendations have been made that the legal limit should be lower. Recently, this recommendation has again been made by several groups. For example, Mothers Against Drinking Drivers (MADD) Canada, the Ontario Medical Association and the Addictions Foundation of Manitoba and Citizens Against Impaired Driving have adopted as a formal position the recommendation that the legal limit be reduced to 50 mg%. MADD has presented survey evidence that the majority of Canadians support a reduction in the legal limit to 50 mg% and in presenting that evidence it called on the Federal Government to, "Review the Criminal Code to lower the legal Blood Alcohol Concentration (BAC) level from 80 mg/dl to 50 mg/dl".

The purpose of this review is to estimate the potential impacts of lowering the legal limit in Canada to 50 mg%. Four lines of evidence which are most relevant to estimating the effects of a reduction of the legal BAC limit to 50 mg% are considered. The first is research on the effects of alcohol on the skills and abilities necessary to drive an automobile (i.e., experimental studies). The second line of evidence is epidemiological research on the BACs found among various groups of drivers and the risk of collision involvement at various BACs. The third line of evidence is research on the impact of lowering the legal BAC in other countries and jurisdictions. Lastly, other possible impacts of lowering the legal BAC are noted, such as public acceptance, police discretion and possible judicial and penal outcomes.

A large number of experimental studies have been conducted on the impact of low doses of alcohol on driving-related skills, and it is clear that the impairing effects of alcohol on the skills necessary to drive safely begin at low BACs and increase with increasing BACs. In a major review by Moskowitz and Robinson (1988), the authors examined detailed aspects of overall

performance. In reaction time studies, of the 41 studies reviewed, 14 reported reaction time deficits at BACs of 50 mg% or less and only 2 studies did not find impairment levels at BACs of 60 mg% or more. Three areas of cognitive function were studied: concentrated attention; divided attention; and information processing. In terms of concentrated attention, the studies were equivocal for BACs above 50 mg% and no studies showed impairment below 50 mg%. However, for divided attention tasks, 13 of the 15 studies reviewed found impairment at levels below 80 mg%. For information processing, 18 of 25 studies found impairment below 80 mg%. Overall, the experimental evidence indicates that many indicators of performance are affected at BACs of 50 mg% and below. However, variation in these effects occurs. For example, the intensity of effects are greater when BAC levels are rising than when they are falling. There also can be considerable variation among individuals at the same BACs in terms of psycho-motor coordination. For example, it is well known that regular drinkers of alcohol may display less extreme effects of a particular BAC than occasional drinkers. Degree of learning with respect to a particular task may also affect ability to accomplish the task under the effect of alcohol.

Epidemiological research has allowed identification of the impact of alcohol consumption on the risk of collision involvement. The results of this work provide a scientific foundation for efforts to reduce impaired driving, because it demonstrates clearly the staggering impact of alcohol on collision risk. Increases in BACs increase the risk of collision involvement exponentially. Of greatest interest here is whether or not alcohol increases risk for collisions at BACs in the 50 to 80 mg% range, that which would be affected by the proposed reduction in the legal limit. The studies reviewed suggest that, overall, individuals in the 50 to 80 mg% range are one and a half to ten times more likely to be involved in a collision than a person who had not been drinking. The actual relative risks depend on factors such as age, drinking frequency and type of collision.

Internationally, there has been a general downward trend over the past few decades in legal BAC limits (Peacock, 1992). There are substantial variations between countries in BAC limits, although most nations appear to have a limit of 50 or 80 mg%. Some countries and jurisdictions have reduced the legal limit for young or new drivers, often to the point of prohibiting driving after any consumption of alcohol. In the United States, substantial variability exists in terms of

legal limits. Recently, several influential government agencies and groups in the U.S. (National Highway Traffic Safety Administration, Mothers Against Drunk Driving) have been working to encourage all states to adopt a legal BAC limit of 80 mg%. In Australia, most states have a 50 mg% limit. In Great Britain, a proposal to lower the legal limit from 80 mg% to 50 mg% is currently under consideration. In Canada, although the legal per se limit is set at 80 mg% in the Criminal Code, many provinces provide a minor sanction at BACs under 80 mg% under the provincial highway traffic acts.

Many evaluations of the impact of introducing or lowering a legal BAC limit have been reported. Early studies of the impact of the original introduction of the per se laws in Great Britain and Canada indicated a beneficial impact on collision measures in the short term, but these benefits dissipated over time. More recently, several evaluations of the impact of lowering the legal limit to 50 mg% or lower have been reported. In every jurisdiction in which a 50 mg% or lower BAC limit has been implemented and evaluated, a beneficial impact on collisions, injuries and fatalities has been reported. However, in some jurisdictions the beneficial effects were temporary. Several studies employ rigorous analytical procedures to control for the effects of other variables which may be influencing the results. These studies suggest that the maximum impact of a 50 mg% BAC limit could be a 6% to 18% reduction in total motor vehicle fatalities; in other words an estimated decrease of between 185 and 555 fatalities per year in Canada. Some studies examining which drivers are affected by a reduced BAC limit suggest that the drivers most affected are those at higher BACs (e.g., above 150 mg%), who represent the greatest risk as individuals.

Very little research exists on potential negative consequences of lowering the BAC limit from 80 mg% to 50 mg%, but there may be resulting costs and harms that need to be considered. One factor that could influence the likelihood of negative impacts is acceptance of any new legislation by the public and by police and judicial authorities. If a new law is regarded as too severe by many police or judicial authorities, then differential enforcement and judicial practices

could arise. Furthermore, if the general public strongly disagrees with new legislation then it may have little deterrent value. As well, if a decision is made to introduce a lower legal BAC limit, a failure to provide the police with resources necessary to enforce the law could jeopardize any beneficial impact it would have.

Chapter 1

DRINKING AND DRIVING IN CANADA: A CONTINUING PROBLEM

Motor vehicle collisions remain one of the largest contributors to alcohol-related premature death and morbidity, but unlike many other causes of mortality and morbidity, motor vehicle collisions are preventable. Legal initiatives continue to be the key to successful efforts to reduce the economic, social, and personal costs of drunk driving. A large number of legal initiatives, enforcement efforts and prevention programs introduced over the past two decades were associated with important decreases in alcohol-related collisions and deaths (Beirness, Simpson, Mayhew and Wilson, 1994; Mann, Smart and Anglin, 1996; Wilson and Mann, 1990). However, alcohol continues to be a factor in 43% of all traffic fatalities in Canada (e.g., Beirness, Simpson, Mayhew and Brown, 1996). Although important decreases were achieved in the past, in the last few years levels of drinking-driving have remained relatively stable. Thus, there continues to be a need to improve impaired driving countermeasures in order to reduce collisions, injuries and deaths resulting from drinking-driving.

Sometimes impaired driving initiatives are seen solely as enforcement or legal measures designed to deter impaired driving. However, they are also health measures which can have an extremely important impact on the mortality and morbidity associated with collisions (e.g., Mann, Anglin, Wilkins, Vingilis, Macdonald and Sheu, 1994). Alcohol-related collisions result in large costs to the individuals affected, their families and to society at large.

Motor vehicle collisions are the third leading cause in Canada of years of life lost after cancer and heart disease (National Cancer Institute of Canada, 1991), and 43% of these deaths involve alcohol (Beirness et al., 1996). Vodden, Smith, Meng, Miller, Lall, Beirness, Mayhew, Simpson, Kazakov and Tasca (1994) found that in 1990 in Ontario alone there were 1,145 fatalities, plus 10,052 major injuries and 64,852 minor injuries, as a result of motor vehicle collisions. They estimated that about $658,000 in future earnings would be lost for each traffic death. They also estimated that all fatalities and injuries from all collisions would result in $157 million in health care costs. However, certain health costs such as operating rooms and long term health care were not included, which probably resulted in an underestimate.

Single, Robson, Xie and Rehm (1996) examined the costs specifically due to alcohol and other drugs in Canada and estimated that alcohol-related traffic collisions in 1992 resulted in direct costs for damage of $482.8 million nationally. Motor vehicle fatal injuries accounted for 13% of all hospitalizations and 12% of all days in hospital caused by alcohol. They were also the largest contributor to alcohol-related deaths and potential years of life lost, accounting for 22% and 33% of those respectively. Xie, Rehm, Single and Robson (1996) examined Ontario data specifically and found that in 1992 there were 488 deaths attributable to alcohol-related traffic collisions. There were 3,194 hospital separations attributable to alcohol-related collisions, involving an estimated 37,732 days in hospitals.

Legal Measures as the Basis for Control of Drunk Driving

Legal measures are viewed as the foundation of successful efforts to reduce drunk driving and its associated collisions, injuries and fatalities (e.g., Homel, 1988; Jonah and Wilson, 1983; Ross, 1984 and 1991; Surgeon General, 1989; Transportation Research Board, 1987; Voas and Lacey, 1990; Vingilis, 1990). Zimring (1988) noted that with recognition of the large potential impact of such factors as drunk driving laws on highway deaths and injuries, these laws and related issues became part of the public agenda. In comparison to other developed countries, there was historically a low level of concern with alcohol and traffic safety in Canada, Great Britain and the United States (Zimring, 1988). However, with the recognition of the magnitude of the drunk driving problem, considerably more attention began to be paid to this issue. The key to efforts to reduce this problem in recent years appears to have been the adoption of what has been termed the 'Scandinavian model' of deterrence of drunk driving. In this model, laws which make it an offence to drive with a blood alcohol level beyond a certain limit are implemented (Andenaes, 1984; Ross, 1973) and are combined with such sanctions as licence suspensions and jail terms. These laws are termed per se laws, and they greatly facilitate the apprehension and prosecution of drunk drivers. The country credited with introducing the first per se law is Norway, which made it an offence to drive with a Blood Alcohol Concentration (BAC) of 50 mg% in 1936 (Voas and Lacey, 1990).

Prior to 1969 in Canada, the evidential basis for a conviction for a drunk driving offence

was behaviourally based. That is, in order to obtain a conviction for impaired driving, the arresting officer had to present evidence in court that an individual was impaired based on behavioural observations. The law which made it an offence to drive with a BAC of 80 mg% or more was introduced in 1969. This per se law ushered in the modern generation of drinking-driving countermeasures in Canada. It enabled a large scale and continuing attack on drinking and driving based on general deterrence, large-scale enforcement campaigns, and public awareness. Subsequent changes to the Canadian Criminal Code were undertaken to facilitate the use of general deterrence in reducing the drinking driving problem. In 1976, the Criminal Code was modified to permit police to request a screening breath sample on the suspicion that the driver had been drinking. In 1985, it was further revised to create new offences of dangerous or impaired driving causing bodily harm or death, with sentences ranging up to 14 years imprisonment, higher fines and telephone warrants for blood tests (Liban, Vingilis and Blefgen, 1987).

Canada's per se law was modelled on the British Road Safety Act of 1967, including the selection of 80 mg% as the legal limit. Among the reasons for choosing the legal limit of 80 mg% were clear evidence of increased collision risk and behavioural impairment at those levels (e.g., Borkenstein et al., 1964; Carpenter, 1962). The British Road Safety Act itself was based on the Scandinavian approach to preventing drinking driving, as noted above, where chemical tests and per se laws formed a key component.

One recommendation that has been made almost since Canada's per se law was introduced is that the legal limit for per se prosecution should be lower (e.g., Whitehead, 1975). Recently, this recommendation has been made by some very influential groups. For example, Mothers Against Drinking Drivers (MADD) Canada, the Ontario Medical Association (OMA, 1994) and the Addictions Foundation of Manitoba and Citizens Against Impaired Driving (Cormier, 1995) have adopted as a formal position the recommendation that the legal BAC limit be reduced to 50 mg%. Many community groups are supporting that recommendation. MADD has presented survey evidence that the majority of Canadians support a reduction in the legal limit to 50 mg% and in presenting that evidence it called on the Federal Government to, "Review the Criminal Code to lower the legal Blood Alcohol Concentration (BAC) level from 80 mg/dl to 50 mg/dl," (MADD

Canada, 1997). In other countries, a 50 mg% legal limit has been officially supported by such groups as the American Medical Association (American Medical Association Council on Scientific Affairs, 1986), the National Committee on Injury Prevention and Control, and the British Medical Association (British Medical Journal, 1995). Currently, Great Britain is examining its impaired driving laws. A lowering of the legal limit from 80 mg% to 50 mg% has been recommended by a Select Committee of the House of Lords (1998), although they also suggest that the overall impact of this measure, by itself, would be relatively small.

In this review, the evidence relevant to predicting the likely impact of reducing the legal limit to 50 mg% will be examined. The primary purpose of the review is to estimate the potential traffic safety impact of lowering the legal BAC limit in Canada to 50 mg%.

Scope of this Review

Four lines of evidence are most relevant to estimating the impact of a reduction of the legal BAC limit to 50 mg%, and will be considered in the review. The first is research on the effects of alcohol on the skills and abilities necessary to drive an automobile. This literature permits an evaluation of the impact of alcohol, at the BACs in question, on the behavioural, cognitive and attitudinal skills and processes involved in, or related to, driving. These effects provide the pharmaco-behavioural substrate for any possible traffic safety effects. Several recent authoritative summaries of the effects of alcohol on basic behavioural and cognitive processes at low to moderate BACs will be summarized.

The second line of evidence is epidemiological research on the BACs found among various groups of drivers and the risk of collision involvement at various BACs. Evidence on the BAC distributions of drivers on the road, those involved in collisions, and those arrested by police will be summarized. While data from all jurisdictions will be considered, Canadian data from roadside surveys, such as those conducted across Canada in the mid-1980s (e.g., Beirness, Mayhew, Simpson and Stewart, 1995), from investigations of BAC distributions of injured collision-involved drivers (e.g., Stoduto, Vingilis, Kapur, Sheu, McLellan and Liban, 1993), and from investigations of BACs of drivers charged with a drinking-driving offence (e.g., Anglin, Caverson, Fennell, Giesbrecht and Mann, 1997) will be highlighted here. As well, research on the increase in

collision risk found in drinking-drivers will be summarized. These studies typically involve a case-control design, such as the Grand Rapids study (Borkenstein et al., 1964), and compare the incidence of particular BACs among drivers who have been involved in collisions to those in control samples of drivers who are not collision-involved.

The third line of evidence is research on the impact of lowering the legal BAC. Here, both the general effects of introducing or lowering a legal limit, and the specific effects of lowering the limit to 50 mg% or lower, will be examined. The evidence considered will include both self-report (e.g., Aberg, 1995) and collision-derived (e.g., McLean, Kloeden, McColl and Laslett, 1995) measures of impact. In this context, it is also important to consider what mechanisms might be operating in any instances where a beneficial impact of a reduced BAC is observed, for example whether any observed impact of a reduced legal BAC limit is specific to the group of drivers who drive at the BACs affected, or whether there is a more general impact of the measure on drinking-drivers.

In an effort to obtain the most current and relevant information for this review, the members of the International Council on Alcohol, Drugs and Traffic Safety (ICADTS) were surveyed. This organization was founded in 1947, and its membership is restricted to individuals who have made key contributions to research, policy, and programs in this field. The survey and the response to it by ICADTS members are described in Appendix A. The survey responses have also been used to identify what legal limits exist in Canada and other countries.

Finally, other possible impacts of lowering the legal BAC limit will be noted. Here, issues such as public acceptance, police discretion and possible judicial and penal outcomes will be discussed.

Chapter 2
EFFECTS OF ALCOHOL ON BEHAVIOURS AND SKILLS RELATED TO DRIVING

In this chapter, the key question is whether or not a BAC of 50 mg% can cause motor vehicle collisions. For a variety of reasons, no single study can by itself answer this question. The 'ideal' experiment, where drivers could be randomly assigned to have a BAC of 0 or 50 mg% and then followed up to determine collision involvement, cannot be performed for obvious ethical reasons. Instead, evidence bearing on this issue must be sought in laboratory analogue studies or correlational studies of the collision experience of drivers at different BACs. In these circumstances, it is important to see a convergence of evidence from different lines of research before a causal conclusion can be drawn.

Experimental Studies

Factors Affecting BAC Levels

Since alcohol is water soluble and the alcohol molecule is relatively small, it enters the central nervous system quickly and is evenly distributed throughout all body tissues (Julien, 1981). However, several factors can influence the rate of absorption of alcohol and resulting BAC (Vogel-Sprott, 1992). The most widely known factor related to BAC after consumption of a particular dose of alcohol is an individual's weight, but other factors are relevant as well. For instance, alcoholic beverages that are between 15 to 30% absolute alcohol are absorbed most rapidly. Food in the stomach can slow absorption. Alcohol is highly water soluable, but not fat soluable. Thus, individuals who have a higher proportion of fat in their total body weight will have a higher BAC from a particular dose of alcohol than those with a lower proportion of fat. Increased carbonation of drink also results in increased absorption of alcohol. Many factors are related to BACs among individuals, given ingestion of the same amounts of absolute alcohol. Alcohol is metabolized at different rates among individuals but the rate of metabolism for an individual does not depend on BAC, and is constant over time (Vogel-Sprott, 1992).

Variations in Performance at the same BACs

Variation in psycho-motor skills can occur for the same individual with the same BAC. For example, the intensity of effects are greater when BAC levels are rising than when they are falling (Ritchie, 1985). Expectations of individuals in terms of alcohol effects can also influence the actual behavioural effects (Hull and Bond, 1986; Fillmore and Vogel-Sprott, 1996b). For example, Fillmore, Carscadden and Vogel-Sprott (1998) recently demonstrated that the impairing effects of alcohol on information processing in male social drinkers were increased when subjects believed that the effects would be larger, and decreased when subjects believed that the effects would be smaller.

There can also be considerable variation among individuals at the same BACs in terms of psycho-motor coordination and information processing. For example, it is well known that regular drinkers of alcohol may demonstrate tolerance, that is, the impact of a particular dose is less than observed with occasional drinkers (Vogel-Sprott, 1992). Degree of learning with respect to a particular task may also affect abilities with respect to task performance under the influence of alcohol. With prior learning under the influence of alcohol, performance can be less impaired (Vogel-Sprott, 1992). Fillmore and Vogel-Sprott (1996a) found that after two years of social drinking, young drinkers are more tolerant to the effects of alcohol. A review of the literature by Holloway (1995) concludes that the effects of alcohol vary considerably for a given individual, depending on the situation.

The Impact of Alcohol on Performance

Aside from differences among individuals and for the same individual at different points in time, a large number of experimental studies have been conducted on the impact of low doses of alcohol on driving-related skills (Moskowitz and Robinson, 1988; Krüger, 1993). In a review of 220 experiments with good methodology, Krüger (1993) examined three main indicators of performance examined by studies: psychophysical functions, automatic processing and control actions. A broad class of functions fall into the category of psychophysical functions, including vision, psycho-motor functioning and memory. At very low doses (i.e., below 30 mg%) vision is

affected in terms of coordination of both eyes (binocular vision) and sensitivity to brightness and colours. Depth and motion vision are affected at doses generally greater than 50 mg%. In terms of psycho-motor functioning, low level hand tremors can be found at very low doses. For memory functions, doses below 80 mg% do not noticeably alter storage and recall of information. Most studies show deficits in automatic processing beginning at about 50 mg%, and increasing continually with rising BACs. Control actions, which involve activities such as multiple tasking, begin to diminish at BACs as low as 30 mg%. Table 1 summarizes these observations.

In the review by Moskowitz and Robinson (1988), the authors examined more detailed aspects of psychomotor and cognitive performance (see Table 2). In terms of reaction time, of the 41 studies reviewed, 14 reported performance deficits at BACs of 50 mg% or less and only 2 studies did not find impairment levels at BACs of 60 mg% or more. Three aspects of cognitive function were examined: concentrated attention, divided attention, and information processing. When concentrated attention was considered, the studies were equivocal for BACs above 50 mg% and no studies showed impairment below 50 mg%. For divided attention tasks, greater convergence was found, with 13 of the 15 studies reviewed finding impairment at levels below 80 mg%. For information processing, 18 of 25 studies found impairment at BAC levels under 80 mg%.

Table 1. Summary of Krüger□s (1993) Review of Experimental Studies

SKILLS EXAMINED	Deficits Can Occur
Psychophysical Functions:	
binocular vision and sensitivity to brightness	30 mg %
depth and motion vision	50 mg%
memory	80 mg%
automatic processing	50 mg%
control actions	30 mg%

For optometric visual functions (i.e., those most likely to be tested by an optometrist) many studies have found impairments at BACs below 50 mg%. The effects of alcohol on perception

appear less severe, as the majority of studies did not show deficits until BACs of at least 80 mg%. The final indicator examined, psychomotor performance, includes a wide array of measures (re: steadiness, coordination, speed and accuracy). Generally, noticeable impairment could be found at levels of 50 mg% and higher.

Table 2. Summary of Moskowitz and Robinson□s (1988) Review of Experimental Studies

SKILLS EXAMINED	Deficits Occur
Overall Performance	14 of 41 studies, deficit at 50 mg % or less 2 studies, deficit at 60 mg % or more
Cognitive Functions:	
concentrated attention	7 studies, deficit at > 50 mg%
divided attention tasks	13 of 15 studies, deficit at < 80 mg%
information processing	18 of 25 studies, deficit at < 80 mg%

Further support for these observations is found in Koelega (1995). He reviewed the research evidence specifically on the impact of alcohol on vigilance performance. He concluded that the main effect of moderate doses of alcohol is on attention and information processing, with the capacity to divide and sustain attention already being impaired at BAC levels of 20-30 mg%.

Although research on the effects of alcohol on specific tasks or behaviours is useful, an important question is how alcohol affects driver performance in general. Laboratory studies of driving involve either driving simulators or actual road tests. Of the 22 studies reviewed by Moskowitz and Robinson (1988), 7 studies found deficits below 50 mg% and another 5 studies found deficits at or between 50 mg% and 80 mg%. Generally, BACs below 80 mg% have been associated with significant impairment in steering, braking, speed control, lane tracking and gear shifting. It is also important to note that apparent differences between studies may be due to a variety of factors. For example, some studies may use tasks or measures that are more sensitive to impairment than others, or may employ a larger sample size, and thus be more likely to yield significant results. Another factor could be time of testing. Research has shown that performance tested on the rising limb of the BAC curve reveals greater impairment than performance tested on the falling limb of the curve (Vogel-Sprott, 1992).

In summary, the experimental evidence reveals that many indicators of performance can be affected at BACs of 50 mg% and below. However, there is considerable variation in the effects of alcohol at all BACs, and some people will be more affected at a BAC of 50 mg% than others.

BAC Levels Among all Drivers, Arrested Drivers and Collision-Involved Drivers

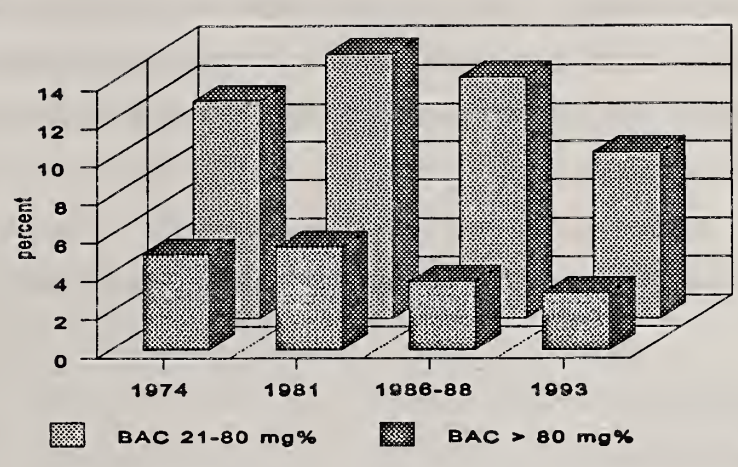
There has been a significant reduction in the number of alcohol-related motor vehicle collisions in Canada over the past twenty years. This reduction has been attributed in part to the introduction and increased use of drinking-driving countermeasures which took place in the 1980s (Beirness, Mayhew, Simpson, Stewart, 1995; Wilson and Mann, 1990) although the evidence on causality is not conclusive.

Roadside surveys have been conducted in order to estimate the prevalence of drinking and driving in Canada. Beirness et al. (1995) combined provincial nighttime surveys conducted between 1974 and 1993 to estimate the general trends in BAC levels among nighttime Canadian drivers (see Figure 1). They observed a general decrease in drinking-driving, i.e., drivers with BAC levels over 20 mg%. This proportion declined from 16.4 % of all drivers in 1974 to 11.7% in 1993. However, although there appeared to be a general decrease in the overall level of drinking-driving in Canada, drivers with very high levels of BAC (over 150 mg%) appeared to be

unaffected by this trend (Beirness et al., 1995). The greatest improvement was observed in low BAC (1-80 mg%) to moderate BAC (81-150 mg%) drivers, implying that different countermeasures which are targeted to reduce drinking and driving in the hardcore drinking group are needed (Simpson and Mayhew, 1991).

Alcohol is also frequently found among drivers who have been injured in motor vehicle collisions. Stoduto et al. (1993) examined the incidence of alcohol and drugs among seriously injured motor vehicle collision victims admitted to a Regional Trauma Unit in Toronto, Ontario.

Figure 1. BAC Trends Among Drinking Drivers in Canada



1974: all provinces
1981: Quebec, Saskatchewan
1986, 1987, 1988:
Nova Scotia, Quebec, Saskatchewan
1993: Nova Scotia, Saskatchewan

Source: Beirness et al., 1995

Data were collected over a 37 month period and out of 543 drivers, 35.5% tested positive for alcohol. The mean BAC at the time of hospital admission among the BAC positive drivers was 145.2 mg%. Because the delay between the time of the crash and being admitted to the hospital can be quite lengthy, they conservatively estimated the mean BAC to be 180 mg% at the time of the crash. The distribution of drivers' BACs at the time of admission and estimated at the time of crash are presented in Table 3. The estimated proportion of drivers in the 50-80 mg% range at the time of crash is nearly identical to the proportion observed in fatally injured drivers (e.g., Beirness, Haas, Walsh and Donelson, 1985).

Table 3: BACs of Drivers Injured in Collisions and Admitted to a Regional Trauma Unit

	BAC (mg%)			
	1 - 49	**50 - 80**	**81 - 150**	**> 150**
BAC at Time of Admission	22.8 %	12.4 %	26.9 %	37.8 %
Est. BAC at Time of Crash	6.3 %	6.8 %	25.0 %	61.9 %

Source: Stoduto et al., 1993

Law enforcement officers apprehend and charge drunk drivers. Recently, Anglin et al. (1997) examined data on 336 impaired drivers who were detected and stopped by the police in the city of Sudbury, Ontario, between January, 1995 and May, 1996. The distribution of BACs

among drivers who were brought in for breath testing under suspicion of driving under the influence of alcohol is presented in Table 4. Approximately 97% were driving over the legal limit of 80 mg%. Of the 8 drivers who were under the 80 mg% limit 4 had a BAC between 50 and 80 mg%.

Table 4: BACs of Drivers Apprehended and Breath-Tested by Police in Sudbury

BAC	Number of Drivers	Percent of Those Tested
under legal limit	8	3
80 mg% to 160 mg%	101	36
more than 2 to 3 times over	133	48
more than 3 to 4 times over	35	13
more than 4 to 9 times over	2	1

Source: Anglin et al., 1997

Clearly, the large majority of Canadians on the road at any time have a BAC of 0 mg%. Of those who have a positive BAC, the majority are below the current legal limit of 80 mg%. Among drivers injured and killed, however, it appears that the proportion with positive BAC levels is still very high. As well, the majority of these have relatively high BAC levels. The data on injured drivers presented by Stoduto et al. (1993) suggested that, of BAC positive drivers, at the time of the crash only 6.8% had a BAC in the range that would be affected by a reduction in the legal limit to 50 mg%. Similarly, drivers currently apprehended and charged by the police appear to be primarily those at higher BAC levels. Anglin et al. (1997) observed that 62% of drivers breath-tested by Sudbury police under suspicion of driving under the influence of alcohol had a BAC more than twice the legal limit of 80 mg%, while only 1.5 % of those tested had a BAC in the 50-80 mg% range.

Alcohol and the Risk of Collision Involvement

Epidemiological research has allowed identification of the impact of alcohol consumption on the risk of collision involvement. This research has in fact been central to the awareness of the

significant problems created by alcohol on the road. Typically, this research employs a variant of the case-control design (Breslow and Day, 1980; Mantel and Haenszel, 1959). Cases are individuals who have been involved in collisions, and whose BACs have been measured. The control sample are typically individuals who are selected for characteristics similar to the cases, or matched to them on specified characteristics. For example, investigators frequently match controls to cases on the basis of the time and location of the case's collision (e.g., Borkenstein, Crowther, Shumate, Ziel and Zylman, 1964).

In spite of the challenges involved in carrying out these studies, several have been reported over the years, beginning with the pioneering work of Holcomb (1938) in the United States and Lucas, Kalow, McColl, Griffith and Smith (1955) in Canada. The results of this work provide a scientific foundation for efforts to reduce impaired driving, because they demonstrate clearly the staggering impact of alcohol on collision risk (Holcomb, 1938; Lucas et al., 1955; McCarroll and Haddon, 1964; Borkenstein et al., 1964). Alcohol increases the risk of collision involvement and the function is exponential. This work has been frequently reviewed and summarized, and all reviewers have arrived at identical conclusions (e.g., Hurst, 1974; Simpson, 1985; Transportation Research Board, 1987). Perhaps the best known of these studies is the Grand Rapids study (Borkenstein et al., 1964). When it first appeared, it provoked considerable discussion because it seemed that the collision risk at low BACs (from 20 to 40 mg%) was lower than that experienced by drivers with a 0 BAC. However, re-analysis of these data, taking into account the possibility of unequal case-control sampling, demonstrated that collision risk was greater for drinking drivers at all BACs (Hurst, Harte and Frith, 1994).

Of particular interest here is whether alcohol increases risk for collisions at BACs in the 50-80 mg% range, that which would be affected by a reduction of the legal limit to 50 mg%. The data from most of the earlier studies described above, unfortunately, are limited in the information provided about this relatively narrow range of BACs, primarily due to sample size. Although these studies may involve a substantial total number of collisions (e.g., the Toronto study reported by Lucas et al. (1955) involved 423 total collisions) when the BAC range is restricted to the 50-80 mg% range the number of collisions involved becomes too small to be meaningful. One exception to this problem is the Grand Rapids Study, which involved 5985 total crashes. The

collision risks at several BAC levels, including the 50-79 mg % range, have been described by several investigators (Hurst, 1974; Vilardo, 1987).

Table 5 presents a summary of the Grand Rapids data reported by Howat, Sleet and Smith (1991). Here, the increases in risk are broken out for individuals with different drinking frequency (yearly, monthly, weekly, three times per week, daily). As can be seen, the risk of collision increases for all categories of drinkers at this level. It is interesting to note that moderate and light drinkers are most impaired at these levels; for example, individuals who drink monthly are 5 times as likely to be involved in a collision at these BAC levels. However, more frequent drinkers also demonstrate increased collision risk in this BAC range.

Table 5: Relative Risk of Crash at Given BACs by Frequency of Drinking

Drinking Frequency					
BAC (mg%)	**Yearly**	**Monthly**	**Weekly**	**3 Times/Week**	**Daily**
0 - 49	1.0	1.0	1.0	1.0	1.0
50 - 79	7.7	5.0	2.0	1.8	1.5
80 - 100	NA	NA	4.5	3.0	3.3
> 100	NA	NA	11.5	8.0	13.0

Source: Howat et al., 1991

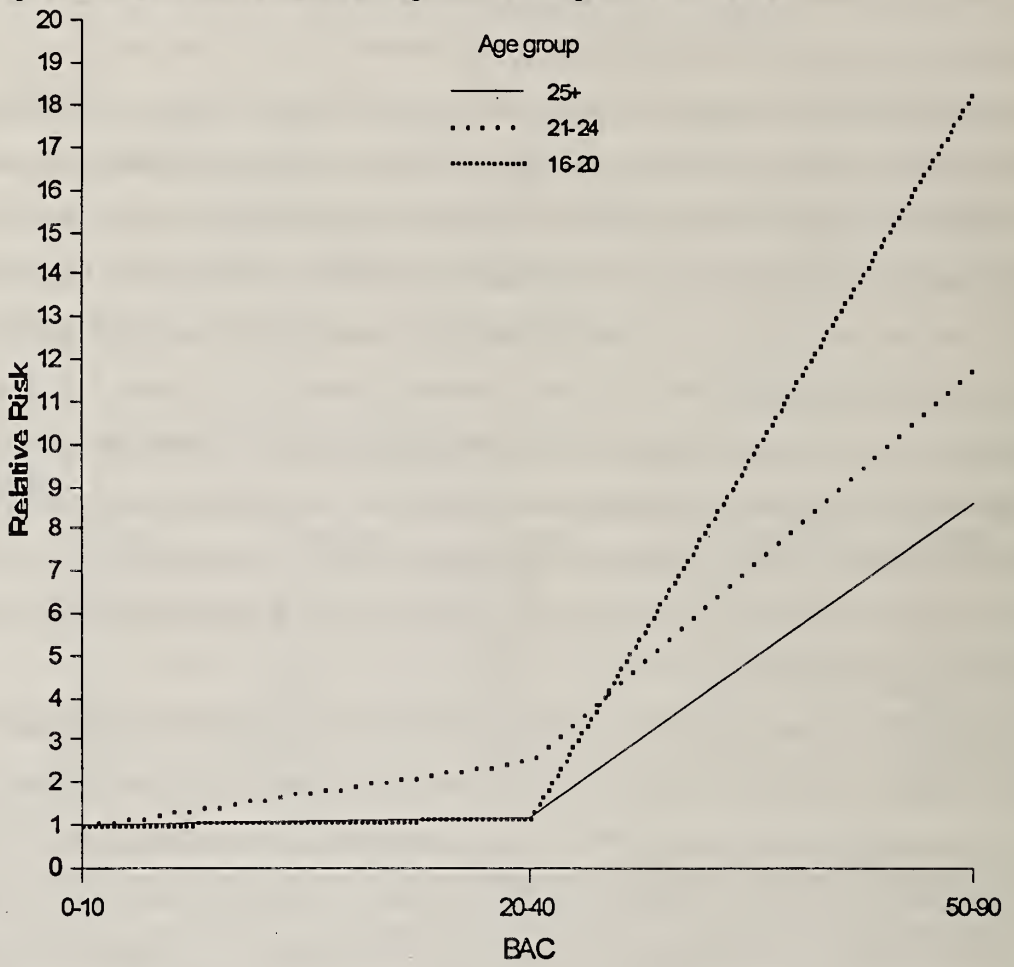
More recent research also supports the conclusions that risk of collision increases with increasing BAC (i.e., that there is no 'threshold' below which collision risk is not increased) and that collision risks are significantly increased in the 50-80 mg% range. Zador (1991) employed data from a national roadside breath-testing survey conducted in the U.S.. He then matched this data set to the Fatal Accident Reporting System data held by the National Highway Traffic Safety Administration for states where at least 80% of fatally injured drivers involved in single vehicle crashes had been tested for alcohol. Fatalities were included in the database only if they occurred at the same times and days as used in the roadside survey. Zador (1991) found that at BACs in the 50-90 mg% range, the likelihood of a fatal crash was at least 9 times greater than at zero BAC for all age groups, and concluded that each increase of 20 mg% in driver BAC from 0 nearly doubles the risk of being in a fatal single vehicle crash. Figures 2 and 3 present the relative risks

up to BACs of 90 mg% for males and females, respectively. Also included in Figures 2 and 3 (in the tables at the bottom) are the relative risks at all BACs, including at higher BAC levels. The exponential nature of the increase in risk is apparent in these numbers, and it is clear that the risk of collision at the highest BAC levels is extreme.

Preusser (personal communication) used the method of induced exposure to estimate the relative risk of fatal crash involvement for varying age groups. He utilized data on 71,443 fatally injured drivers of passenger vehicles tested for alcohol in the U.S. between 1992 and 1996. Induced exposure methods are based on estimations of whether or not particular collisions, or types of collisions involve fault on the part of the driver, and thus differ methodologically from the relative risk studies described above. However, Preusser's results are consistent with the results of the previous studies (e.g., Borkenstein et al., 1964; Zador, 1991). He finds that, across all age groups, the 50 to 70 mg% BAC range appears to double the risk of a fatal collision. He also notes that these effects are most pronounced for younger drivers. For example, drivers in the 21 to 24 age range are about five times more likely to be involved in a fatal collision when their BAC is in the 50-70 mg% range.

Canadian data support the conclusion that collision risks are significantly increased in the 50-80 mg% range. Mayhew and Simpson (1985; see also Simpson, 1985) used procedures similar to those employed by Zador (1991). These authors employed data generated in nighttime roadside surveys in Canadian provinces in 1974 (8,930 drivers surveyed), and matched these data to fatal collision data (1,262 fatally injured nighttime drivers) on the basis of time of collision and type of vehicle driven. The results indicated that "the relative risk of fatal crash increases with increasing BAC for each age group, without exception" (pg. 939). In the 50-79 mg % range, both young drivers (aged 19 and under) and older drivers (aged 20 and above) are at significantly increased risk of collision involvement. The relative risk values presented by Mayhew and Simpson (1985) would seem to suggest that the older drivers are at twice the risk of fatal crash involvement, and younger drivers are at eight times the risk of fatal crash involvement, in this BAC range.

Figure 2. Relative risk for male drinking-drivers in single vehicle crashes*

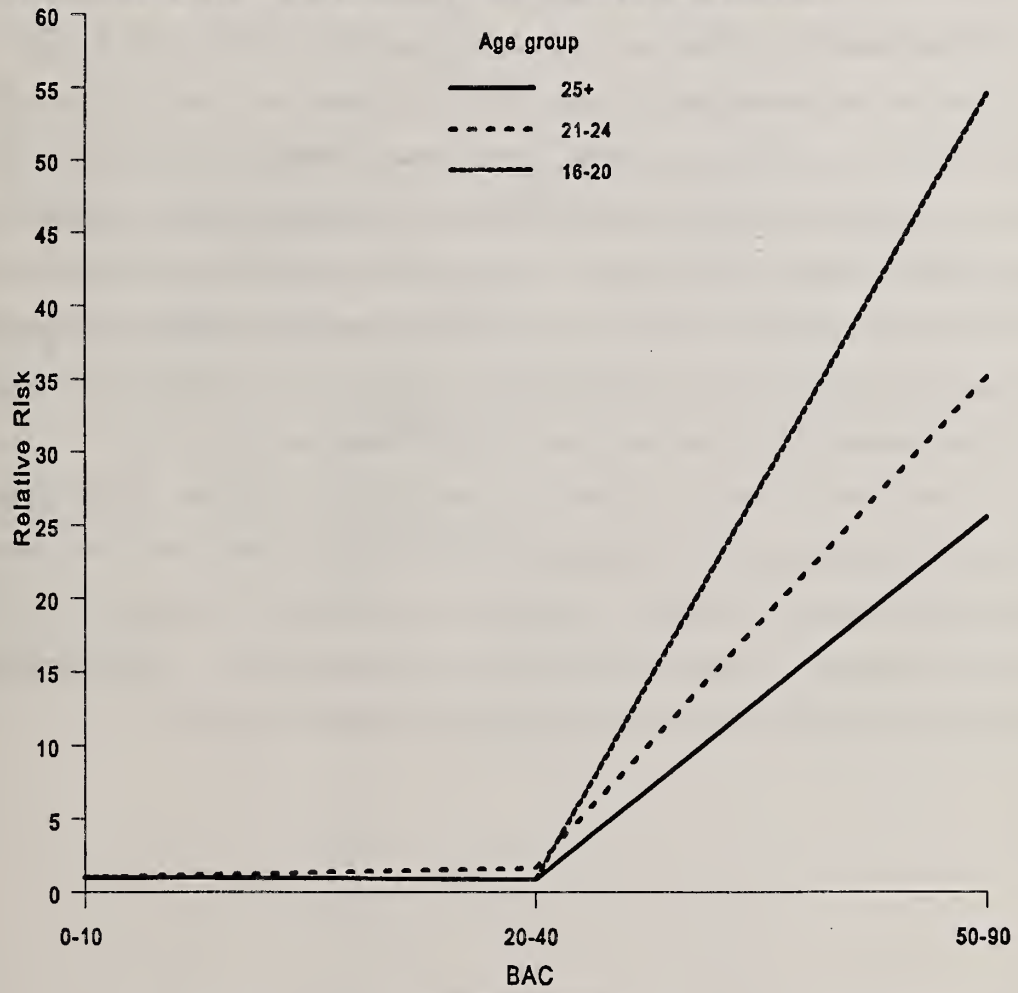


Males	BAC (mg%)			
Age	20 - 40	50 - 90	100 - 140	150+
25+	1.2	8.6	39.7	607.1
21-24	2.5	11.8	135.2	600.7
16-20	1.2	18.3	30.4	349.0

* Relative to crash risk at BAC ≤ 10

Source: Zador, 1991

Figure 3. Relative risk for female drinking-drivers in single vehicle crashes *



Females	BAC (mg%)			
Age	20 - 40	50 - 90	100 - 140	150+
25+	0.8	25.5	118.5	546.5
21-24	1.6	35.1	403.8	540.8
16-20	0.8	54.4	90.8	314.2

* Relative to crash risk at BAC ≤ 10

Source: Zador, 1991

Summary

Research evidence indicates that many behavioural and cognitive skills are impaired at a BAC of 50 mg%, and that drivers are significantly more likely to be involved in collisions at that level. Drivers in younger age groups appear to have a greater increase in collision risk after drinking than drivers in older age groups. These effects increase with increasing BACs. Thus the evidence continues to support the conclusions drawn by Starmer (1989). In reviewing similar evidence to that examined here, he said, "...it is apparent that significant deficits due to low doses of alcohol (which will produce a BAC of [50 mg%]) are readily identifiable and measurable in many tests of perceptual and motor skills related to those involved in driving a vehicle and that these deficits extend to simulated and actual driving impairment." (pg. 122).

However, research does not indicate what the legal limit should be. On this issue, Smiley (1990) noted that research clearly indicates that alcohol impairs performance and increases collision risk, and thus that research "...can support any BAC limit." However, she also continued on to say that research "... cannot be used to support a particular limit .... It is a decision for policy makers, and not for those who do experimental studies," (pg. 120).

Chapter 3

AN OVERVIEW OF CURRENT LEGAL LIMITS

Internationally and within countries, a wide variety of legal BAC limits exist. Tables 6 through 9 present these limits based on responses to the survey of ICADTS members and on information presented in Peacock (1992). In Table 6, the legal limits for all drivers in different countries show considerable variation. Some countries have a 0 BAC limit and others have no legal limit; however, the large majority of countries have a limit of 50 or 80 mg%.

Table 6. **International Legal Blood Alcohol Limits (mg%)**

	per se Limit
Australia	50 (see Table 9)
Austria	80
Belgium	50
Bulgaria	50
Canada	80 (see Table 10)
Croatia	50
Czech Republic	0
Denmark	80
Federal Republic of Slovakia	0
Federal Republic of Yugoslavia	50
Finland	50
France	50
Germany	80
Greece	50
Hungary	0
Iceland	80
India	80
Ireland	80
Italy	80
Japan	0
Luxembourg	80
Macedonia	50
Malaysia	0
New Zealand	80/ 30
Netherlands	50
Northern Ireland	80
Norway	50
Poland	30
Portugal	50
Puerto Rico	100
Romania	0
Saudi Arabia	0
Slovenia	50
South Africa	80
Spain	30/50/80 (buses/trucks>3,500 kg/ all others)
Sri Lanka	80
Sweden	20
Switzerland	80
Turkey	0
United Kingdom	80
United States	100/80 (see Table 8)

Generally speaking, there has been a downward trend the past few decades in legal BAC limits internationally (Peacock, 1992). One notable exception occurred during the unification of Germany, where East Germany's BAC limit was increased from 0 to 80 mg% to match the legal limit in West Germany. Preliminary data show an increase in alcohol-related collisions and fatalities in the east (Vingilis and Fischer, 1995); however, the increase could be attributable to numerous confounding influences.

Table 7. Western Countries with 50 mg% Blood Alcohol Limits or Lower

Country	**per se Limit**	**Criminal/ Administrative**	**Sanctions that can be applied at the lower limit**
Australia	50	Criminal	(see Table 9)
Belgium	50	*	BAC > 50 mg%: first offence: suspension for few hours, subsequent offences: longer suspension, eventual imprisonment possible
Finland	50	Criminal	BAC 50-150 mg%: fine or up to 3 months jail term, could loose insurance
France	50	Administrative or offence	BAC 50-80 mg%: fine and 3 points (temporary vehicle confiscation optional)
Greece	50	Criminal	*
Netherlands	50	Criminal	BAC > 50 mg%: fine and suspension 6 months to 10 years
Norway	50	Criminal	BAC 51-100 mg%: minimum of 2 years suspension plus fine and jail term (conditional)
Portugal	50	Criminal	*
Spain	30/ 50/ 80	Administrative[1]	BAC > 30 mg% only for drivers of dangerous goods or buses BAC > 50 mg% only for truck (>3,500 kg) drivers: up to 100,000 points, fine and 6 months suspension
Sweden	30	Criminal	BAC ≥ 30 mg%: suspension 3 months to 3 years, possible up to 6 months jail term (aggravated offenceswith BAC ≥ 100 or clearly DUI: 12 months suspension minimum plus 1 month to 2 years jail term)

* Unavailable at this time

[1] No legal limit in criminal law. Courts decide whether the driver was impaired. If driver is found to be impaired, sanctions are: up to 1 million points, and/or 5 years suspension and/or 6 months jail term.

Sanctions which can be applied in western countries which have BAC limits of 50 mg% or lower range from minimal to severe (see Table 7). Also, the type of law governing these BAC limits varies between countries, i.e., whether it is administrative or criminal. The use of incarceration as a penalty at low BACs, although permitted in some countries, appears to be very rare in practice.

In the United States, each state sets its own legal BAC limit, and these are summarized in Table 8. Some states have separate offences of DWI (Driving While Impaired) and DUI (Driving Under the Influence) or some similar distinction (e.g. Colorado). Both offences are criminal offences, but the DUI offence is typically viewed as more serious, with the potential for more severe punishments, than the DWI offence.

Table 8. United States Legal Blood Alcohol Limits (mg%)[1]

State	*per se* BAC Limit/ Young Driver Limit	BAC Limit for Administrative Licence Revocation	Presumptive BAC
Alabama	80/20	80	80
Alaska	100/0	100	100
Arizona	100/0	100	100
Arkansas	100/20	100	---
California	80/10	80	80
Colorado	100/20	100	50 (DWI), 100 (DUI)
Connecticut	100/20	100	---
Delaware	100/20[2]	100	100 (*prima facie* evidence of DUI)
District of Columbia	100/20	50	50 (*prima facie* evidence of DUI)
Florida	80/20	80	80 (*prima facie* evidence of DUI)
Georgia	100/20	100	80
Hawaii	80/20	80	80 (competent evidence of DUI)
Idaho	100/20	100	---
Illinois	100/0	100	100
Indiana	100/20	100	100 (both *prima facie* & presumptive evid.)
Iowa	100/20	100	---
Kansas	80/20	80	80 (*prima facie* evidence of DUI)
Kentucky	100/20	---	---
Louisiana	100/20	100	100
Maine	80/0	80	---
Maryland	100/20	100	70 (90 days if DWI guilty plea)
Massachusetts	---[2]/20	80	80
Michigan	100/20	---	70 (DWI), 100 (DUI)
Minnesota	100/0	100	---
Mississippi	100/80	100	---
Missouri	100/20	100	---
Montana	100/20	---	100 (show 'hardship'= permit after 30 days)
Nebraska	100/20	100	---
Nevada	100/20	100	---
New Hampshire	80/20	80	80 (*prima facie* evidence of DUI)
New Jersey	100/10	---	---
New Mexico	80/20	80	---
New York	100/20	---	70, 100 (*prima facie* evidence of DWI)
North Carolina	80/0	80	---
North Dakota	100/20	100	---
Ohio	100/20	100	---
Oklahoma	100/0	100	50 (DWI), 100 (DUI)
Oregon	80/0	80	80
Pennsylvania	100/20	---	---
Rhode Island	100/20	---	---
South Carolina	---[2]/---	---	100 (this BAC infers DWI)
South Dakota	100/---	---	100
Tennessee	100/20	---	100, 80 (1st offence: BAC 100=DUI, 2nd offence: BAC 80=DUI)
Texas	100/0	100	---
Utah	80/0	80	---
Vermont	80/20	80	80 (this BAC infers DWI)
Virginia	80/20	80	80
Washington	100/20	100	---
West Virginia	100/20	100	100 (both *prima facie* & presumptive evid.)
Wisconsin	100/20[3]	100	100 (BAC 100 *prima facie* evidence for 1st & 2nd offences, BAC 80 *prima facie* evidence for 3rd & subsequent offences)
Wyoming	100/---	100	---

[1] Note: Under Federal Law the Legal Limit for all Commercial Drivers is 40 mg%.

[2] Laws in Massachusetts & South Carolina aren't *per se* laws. A BAC of 100 mg% in South Carolina and 80 mg% in Massachusetts is evidence of alcohol impairment but isn't illegal *per se*. In Delaware, the 20 mg% BAC law for young drivers isn't a *per se* law.

[3] Special BAC limit for young drivers applies to drivers younger than 21 years of age, except in Wisconsin (19 years of age).

Table 9. **Australian States: Blood Alcohol Levels and Sanctions** (Legal *per se* Limits 50 mg%)

	Penalties on Conviction	
New South Wales	BAC 20-45:	fine, 5 penalty points, 3 months suspension
(over 25 years olds with ≥ 3 years driving	BAC 50-75:	fine, 5 penalty points, 6 months suspension
experience exempt from zero limit)	BAC 80-145:	fine doubled, 10 penalty points, 6 months jail, 12 months suspension
	BAC > 150:	fine doubled, 15 penalty points, 9 months jail, 36 months suspension
Queensland	BAC ≥ 50:	fine, 1-12 month suspension, jail for repeat offenders
South Australia	BAC 50-80:	fine, 3 penalty points
	BAC 80-150:	fine, 5 penalty points, 6+ months suspension
	BAC > 150:	fine, 6 penalty points, 12+ months suspension
Victoria	BAC 50-100:	6 months suspension
(zero limit for learners and new drivers)	BAC 100-240:	1 month suspension for every 10 mg%
	BAC > 240:	24 months suspension

These data have been adapted from summaries of state drinking-driving laws prepared by the National Highway Traffic Safety Administration (1997). Most enforce a 100 mg% per se limit with criminal sanctions; however, 13 have recently lowered the limit to 80 mg% limit. Lower limits or zero tolerance laws for *young drivers* have also been instituted in many states to help reduce drinking-driving in affected age groups. As well, it is important to note that a limit of 40 mg% has been introduced federally for all commercial drivers.

Table 9 summarizes the available information on BAC limits in several Australian states. It is interesting to note that, in several states, a tiered approach to penalties is taken. For example, in Victoria, a BAC in the 50-100 mg% range results in a 6 month licence suspension, for a BAC in the 100-150 mg% range the suspension increases one month for every 10 mg%, and for BACs over 240 mg% a 24 month suspension is applied.

In Canada, the offence of impaired driving is governed by the Criminal Code of Canada, which applies to all provinces. The Criminal Code sets out a number of drinking driving offences: Section 253(a) makes it a criminal offence to drive or have control of a motor vehicle while the person's ability to drive is impaired by alcohol or drugs; Section 253(b) makes it a criminal offence to drive or have control of a motor vehicle while the person has consumed alcohol to the point that the proportion in his or her blood exceeds 80 mg%; and Section 254(5) makes it a criminal offence to refuse to provide a sample of breath for analysis by a roadside screening or breath testing device.

For all these offences, a first offence results in a minimum driving prohibition of 3 months and a minimum fine of $300. A second offence results in a minimum driving prohibition of 6 months and a minimum of 14 days imprisonment. A third or subsequent offence results in a minimum driving prohibition of one year and a minimum of 90 days imprisonment.

As well, the Criminal Code was amended in 1985 to add two new offences. These were impaired driving causing death (255(3)) and impaired driving causing bodily harm (255(2)). The maximum penalties for these offences were set at 14 years imprisonment and 10 years imprisonment, respectively.

Each province also provides sanctions under provincial highways legislation (see Table 10). Currently, most provinces provide a brief penalty (immediate licence suspension, ranging from 6 to 24 hours) for individuals who have a BAC over 50 mg% and under 80 mg% (except Saskatchewan where it is BAC > 40 mg% and under 80 mg%). Several provinces have introduced Administrative Licence Suspensions, which are applied when a Criminal Code drinking-driving charge is laid. As well, upon conviction of a Criminal Code drinking-driving offence, all provinces suspend the driver's licence for a period of time exceeding the period of the Criminal Code driving prohibition, usually a minimum of one year. Finally, several provinces/territories have introduced special lower limits (ranging from 0 to 40 mg%) for young or new drivers.

Table 10. **Canada: Licence Suspensions and Blood Alcohol Limits by Province/Territory (Criminal Code *per se* Limit 80 mg%)**

	Roadside Licence Suspension	Administrative Licence Suspension	Provincial Licence Suspension applied upon Criminal Code Offence[1]	Special BAC Limit for New/Young Drivers
Newfoundland	24 hrs., BAC > 50	No	1 yr./2 yr./3 yr. (Max 5 yr.)	No
Prince Edward Island	24 hrs., BAC > 50	90 days, BAC > 80	1 yr./2 yr./3 yr. (Max 5 yr.)	BAC < 10, for drivers under 19 years old
Nova Scotia	No	90 days, BAC > 80	1 yr./2 yr./5 yr.	0 BAC for 27 months
New Brunswick	24 hrs., BAC > 50	No	6 months/1 yr./1 yr. (Max 3 yr.)	0 BAC for 24 months
Quebec	No	2 weeks, BAC > 80 (2nd offence- 1 month)	1 yr./2 yr./3 yr. (Max 5 yr.)	0 BAC for 24 months
Ontario	12 hrs., BAC > 50 or refuse test	90 days, BAC > 80	1 yr./2 yr./3 yr.	0 BAC for 20 months
Manitoba	6 hrs., BAC > 50	3 months, BAC > 80 or refuse test	1 yr./5 yr./5 yr.	under review
Saskatchewan	24 hrs., BAC > 40	3 months, BAC > 40	1 yr./3 yr./5 yr.	BAC > 40 = penalties
Alberta	24 hrs., BAC > 50	under review	1 yr./3 yr./5 yr.	No
British Columbia	24 hrs., BAC > 50	90 days, BAC > 80	1 yr. (Max 10 yr.)	under review
Northwest Territories	4-24 hrs., BAC unspecified	under review	3 months/6 months/1 yr. (Max 5 yr.)	under review
Yukon Territories	24 hrs., BAC > 80	No	3 months/1 yr./2 yr. (Max 5 yr.)	No

[1] for first/second/third Criminal Code convictions

Chapter 4
EFFECTS OF LOWER BLOOD ALCOHOL LIMITS

Over the years, legal BAC limits have been introduced and changed in many jurisdictions around the world. Frequently these changes have been evaluated. This information is central to an estimation of what might happen in Canada if the legal limit is changed. In this section, we review studies reporting the effects of introducing or lowering specific legal limits. First, the information on introducing a legal limit, or lowering it to 80 mg%, is examined. We then examine jurisdictions where BAC limits have been specifically reduced to low levels or to 0 for young or new drivers. Next, the literature evaluating the impact of reducing the legal limit to 50 mg% or less is reviewed. Finally, evidence on the populations or groups of drivers who appear to be affected by reductions in legal BAC limits is considered.

General Effects of Introducing a Legal Limit or Lowering it to 80 mg%

With the general adoption of the 'Scandinavian model' in developed countries, numerous opportunities for evaluating its impact have arisen. Ross' (1973) examination of the impact of the British Road Safety Act, which introduced a legal limit of 80 mg%, is the pioneer example of the evaluation of a per se law. The law was introduced with great publicity in 1967. Ross' (1973) evaluation was additionally important because he used a time series approach to examine the impact of the measure. The initial impact of the law was dramatic. In the first three months after it was implemented, total traffic fatalities dropped by 23% and total injuries dropped by 11%. These effects were even more pronounced on collisions that more frequently involve alcohol: nighttime and weekend collisions. In the first year after the implementation of the law, the proportion of fatally injured drivers who were legally intoxicated (over 80 mg%) dropped by almost 40%, from 32% of all fatally injured drivers to 20% (Transportation Research Board, 1987).

A gradual increase in collisions occurred over several months and years following its introduction (Ross, 1973). In the months preceding the introduction of the law, there were about 1,200 fatalities and serious injuries resulting from nighttime collisions each weekend. Immediately

following the introduction of the law, this figure dropped precipitously to about 400. It then began to increase, and by 1970 it had returned to about 1,000. Phillips, Ray and Votey (1984), in a follow-up evaluation, considered whether or not the impact of the law had disappeared completely and concluded that there had been a significant and lasting (although small) impact of the British Road Safety Act on collisions, injuries and fatalities.

In 1970 a 50 mg% limit was introduced in Japan. Deshapriya and Iwase (1996) examined collision trends in the country before and after the introduction of the law. They noted that the proportion of fatal collisions involving alcohol had been increasing before the law was introduced, and began to decline following the law's introduction. They also noted that over the same period alcohol consumption was increasing and the numbers of licensed drivers and registered motor vehicles was also increasing, and concluded that the law had the effect of reducing drinking-driving and alcohol related collisions. However, no statistical tests were reported to support these conclusions.

The Netherlands introduced a legal BAC limit of 50 mg% in 1974. Noordzij (1977) reported on the impact of this initiative on drinking-driving behaviour as measured in a series of roadside surveys and on collisions. It appeared that the introduction of the 50 mg% limit resulted in a very pronounced reduction in the proportion of drivers who had been drinking. The proportion of drivers who had a BAC of 50 mg% or above declined dramatically. According to Noordzij (1977), "...it can be stated that immediately after the change in the law on November 1, 1974, there were practically no drinking-drivers on weekend nights." (pg. 457). However, the impact on collisions was less clear. There did appear to be a substantial reduction in the number of fatal collisions involving alcohol. However, when looking at total fatal collisions, there appeared to be an overall decline in these and the effects of the 50 mg% limit could not be disentangled from other factors, such as the energy crisis of the early 1970s as well as the introduction of moped helmet legislation and seatbelt legislation. Van Ooijen (1977) also examined the impact of the 50 mg% law in the Netherlands. He noted that there was an immediate and substantial impact on alcohol injury collisions. However, some of this impact appeared to wear off over the year following implementation.

Noordzij (1994) examined the long term impact of the Netherlands 50 mg% law on drunk

driving, using the series of roadside surveys that have been conducted in that country. It appeared that the introduction of the limit resulted in a very large drop in drinking-driving. The proportion of weekend nighttime drivers with BACs over 50 mg% dropped from about 15% in the year proceeding the law to less than 5% in the year following the law. There appeared to be a rebound in the proportion of drinking-drivers in the following year, but from then on there was a slow decline in the proportion of drivers who had been drinking. Noordzij (1994) commented that the introduction of the 50 mg% limit appeared to initiate a broad and sustained decline in the numbers of drinking-drivers in the Netherlands.

Efforts to evaluate the impact of Canada's per se law have been made. A publicity campaign was undertaken at the time the law was introduced, in order to educate the public about the law. The impact of this campaign was examined with telephone surveys conducted before and after the law was introduced (Kates, Peat, Marwick and Company, 1970). The results suggested a general awareness of the law, with some exceptions (e.g., the majority of respondents were not aware that they could still be charged with impaired driving with a BAC under 80 mg%). However, attitudes towards drinking and driving appeared not to change, and this observation is consistent with the focus of the media campaign on increasing knowledge of the law but not attempting to influence attitudes (Liban et al., 1987). The traffic safety impact was examined by Carr, Goldberg and Farbar (1974) and by Chambers, Roberts and Voelker (1974). Both groups of investigators found evidence of a modest impact. Carr et al. (1974) noted that, although it appeared that measures of overall driving were increasing (rise in gasoline sales) total road fatalities declined by 6.3% in the year after the law's introduction. Other measures were consistent with a modest impact. The proportion of fatal crashes occurring at times when alcohol is most likely to be involved declined (nighttime fatal collisions declined from 29% to 27% of the total and weekend fatal collisions declined from 58% to 56% of the total). Coroners' data on BAC levels among fatally injured drivers showed little change. Chambers et al. (1974) employed a regression analysis to estimate the impact on traffic fatalities, employing quarterly fatality rates between 1966 and 1971. They found there was a significant reduction in incidence of injuries from traffic collisions following the introduction of the law, with the largest decreases falling between 6 p.m. and 6 a.m., when the highest proportion of drinking-drivers are on the road. However, the reduction in fatality rates

after introduction of the breathalyser only approached conventional levels of statistical significance (p=.11), and Chambers et al. (1974) estimated that the effect of the breathalyser law was a reduction of 487 traffic deaths during the first five months that the law was in place. These effects, then, seemed modest. Evaluation was hampered by problems with the data (e.g., lack of comparability between provinces in collision reporting format). Some researchers concluded overall the effect of the law was likely reduced by insufficient attention being paid to preparing police to using the new law to its maximal utility (Liban et al., 1987).

Several states within the U.S. have reduced the legal per se BAC limit (see Table 7). Beneficial impacts of reducing the legal limit from 100 mg% to 80 mg% have been reported, but it may be too early to judge definitively what the impact of this measure has been. Zador, Lund, Fields and Weinberg (1989) evaluated the impact of a variety of legal initiatives, including introducing per se BAC laws, in American states between 1975 and 1985. Administrative Suspension laws were introduced in 41 states during this time period. Their analysis revealed that introduction of per se laws was associated overall with a 2.4% reduction in total fatal crashes, but this impact was not statistically significant. However, this effect varied according to the estimated level of alcohol use by drivers. There were statistically significant reductions of 5.1 % in collisions with a low probability of alcohol involvement and 8.6% in collisions with a moderate likelihood of alcohol involvement, but the impact on crashes with higher likelihood of alcohol involvement was not statistically significant.

Hingson, Heeren and Winter (1996) reported on the traffic safety impact of lowering the limit from 100 to 80 mg% in five states (Oregon, Utah, Maine, California and Washington) which took this step at varying times between 1983 and 1991. Hingson et al. (1996) matched each state with a neighbouring state which kept a 100 mg% limit over the same time period. The matching procedure was used to control for regional factors which might influence road safety (e.g., economic factors local to specific areas). Hingson et al. (1996) observed a significant reduction, across these states, in the proportion of crashes with a fatally injured driver who had a BAC of 80 mg% or higher. In comparison to states that maintained a legal limit of 100 mg%, those that introduced the 80 mg% limit experienced a reduction of 16% in the proportion of crashes with a fatally injured driver whose BAC was 80 mg% or higher. This effect was not limited

to drivers at the BACs affected by the law (i.e., those in the 80 to 100 mg% range). Instead, when Hingson et al. (1996) examined the proportion of drivers with higher BACs (150 mg% or higher), the reduction was even larger (18%). This observation indicates that reducing the legal limit by 20 mg% to 80 mg% had a general deterrent effect, that is, it influenced drivers at all BAC levels. However, at least some of this effect may have been due to other factors acting to reduce impaired driving, such as the introduction of Administrative Licence Revocation in some of the states over the time period examined.

At the most recent meeting of the Transportation Research Board in Washington (January, 1998), a paper was presented which challenged some of the findings of Hingson et al. (1996). Scopatz (1998) repeated some of the analyses carried out by Hingson et al. (1996) using different comparison states. Scopatz (1998) introduced different comparison states in several stages, and found that the overall reduction in the proportion of drivers over 80 mg% ranged from 14% to 4% (in comparison to Hingson et al.'s [1996] 16%). However, Hingson (1998) noted that Scopatz (1998) did not restrict comparison states to those that were geographically contiguous (e.g., in the comparison that resulted in the lowest reduction in drinking driving fatalities, Scopatz [1998] compared California, a west coast state, to the three-state combination of Michigan, Ohio and Pennsylvania, all of which are east coast states). Thus, it appears to be too soon to draw final conclusions on the size of the beneficial effects of lowering the legal limit in American states.

Table 11 summarizes the studies and the major findings described above. There are several observations that can be made here. First, it appears that beneficial effects are typically observed when legal limits are introduced, or when the limit is lowered to 80 mg%. However, there is variability in the impact of these measures. Thus the impact of introducing an 80 mg% limit appeared to be stronger in Great Britain than in Canada. As well, beneficial effects often appear to decrease over time This variability could depend on differences in the measures used (e.g., collision measures specific to alcohol versus total collisions) and in the historical and social contexts of the countries involved. It is also possible that differences in the methodologies used in these studies contributed to differences in findings. The range in methodological rigour is substantial, going from description of trends in a limited number of measures (e.g., Van Ooijen, 1977) to sophisticated and comprehensive time series analyses (Ross, 1973) and analyses involving

comparison jurisdictions (Hingson et al., 1996; Scopatz, 1998). The majority of studies have been pre-post comparisons (e.g., Noordzij, 1977, 1994; Van Ooijen, 1977; Kates et al., 1970; Carr et al., 1974), and therefore subject to many potential sources of bias.

Table 11. **Summary of Research Evaluating the Effects of Introducing of a Legal BAC Limit or Lowering the Legal Limit to 80 mg%**

Location	Authors	Measures	Design/ Analysis	Impact
United Kingdom; Introduction of 80 mg% per se law in 1967	Ross, 1973	Various indicators of total and alcohol-related collisions	Time series	Introduction of the per se law had a significant and in some instances dramatic impact, which appeared to decrease over time
United Kingdom; Introduction of 80 mg% per se law in 1967	Phillips et al., 1984	Various indicators of total and alcohol-related collisions	Time series	Analyses focussed on whether there was any effect maintained over time (see above) and concluded that there was
Netherlands; Introduction of 50 mg% per se law in 1974	Noordzij, 1977 and 1994	Roadside survey data. indicators of alcohol-involved and total collisions	Pre-post design	Substantial reduction in numbers of drinking drivers and alcohol-related fatalities; effects on total fatalities less clear
Netherlands; Introduction of 50 mg% per se law in 1974	Van Ooijen, 1977	Alcohol-injury collisions	Pre-post comparisons	Immediate and substantial impact on alcohol-related collisions, some of which appeared to wear off with time
Canada; Introduction of 80 mg% per se law in 1969	Kates et al., 1970	Public knowledge and attitudes	Pre-post telephone surveys	Public demonstrated some awareness of the law, but no shifts in attitudes were observed
Canada; Introduction of 80 mg% per se law in 1969	Carr et al., 1974	Various indicators of total and alcohol-related collisions; BAC levels of fatally injured drivers	Pre-post comparisons	Modest reductions in collision measures observed in the year after introduction; no changes in BAC levels
Canada; Introduction of 80 mg% per se law in 1969	Chambers et al., 1974	Collision injury and fatality rates	Time series	Significant reductions in injury rates; reductions in fatality rates marginally significant ($p = .11$)
United States; Introduction of 80 mg% per se laws in 5 states between 1975 and 1985	Zador et al., 1989	Fatal collisions with varying probabilities of alcohol involvement	Time series	Significant reductions in fatal collisions with a low and medium likelihood of alcohol involvement
United States; Introduction of 80 mg% per se laws in 5 states between 1983 and 1991	Hingson et al., 1996	Fatal collisions involving alcohol	Pre-post comparisons, with matched control states	Significant reductions (16%) in proportion of collisions involving a driver with a BAC of 80 mg% or higher
United States; Introduction of 80 mg% per se laws in 5 states between 1983 and 1991	Scopatz, 1998	Fatal collisions involving alcohol	Pre-post comparisons, with matched control states	Significant reductions in proportion of collisions involving a driver with a BAC of 80 mg% or higher, but the magnitude varies depending on which states are used as comparisons

Lowering the Legal Limit for Young or New Drivers

In recent years, young drivers have been the focus of countermeasure efforts in many jurisdictions. One of the principle causes of injuries and fatalities on the road is alcohol, and thus many efforts to improve the road safety record of young or novice drivers have involved alcohol-related countermeasures (Mayhew and Simpson, 1990). Frequently, these measures have involved reducing the legal limit for young or new drivers, often to the point of prohibiting driving after any consumption of alcohol.

Smith (1986) reported preliminary data from three Australian states (Tasmania, South Australia and Western Australia) that introduced a 0 BAC limit for novice drivers. His results indicated that the introduction of this 0 BAC limit for novice drivers resulted in significant reductions in casualty collisions (Smith, 1986). Hingson, Heeren and Morelock (1989) evaluated the introduction in Maine in 1982 of a law making it an offence, punishable by a one year licence suspension, for any person under age 20 to drive with a BAC greater than 20 mg%. They compared Maine data to data from the neighbouring state of Massachusetts where no such measures came into effect, and examined a variety of indicators, including aggregate data on collisions and violations, and telephone survey responses. Comparison of the Maine and Massachusetts survey data suggested a substantial impact of the law, with Maine teenagers reporting a significant decline in drinking-driving behaviour associated with the introduction of the law. Nighttime fatal crashes declined significantly for 15-19 year olds in Maine after introduction of the law; however, they did in Massachusetts as well, suggesting the drop could not specifically be attributed to the introduction of the law.

Subsequently, Hingson, Heeren and Winter (1994) provided further evidence for the beneficial effects of reduced legal BAC limits for young drivers. These authors evaluated the experiences of 12 American states which had introduced lower legal BAC limits for drivers under 21 years of age between 1983 and 1992. Comparing collision data in these states before and after introduction of the laws with data from comparison states, Hingson et al. (1994) found that states which reduced the BAC limits had a reduction of 16% in the proportion of fatal crashes that involved single vehicles at night among affected drivers, while in control states that proportion increased 1%. The size of the reduction was inversely related to the new legal BAC limit, with

the largest reductions occurring for states that reduced the BAC limit to zero.

More recently, reduced BAC limits have been combined with other measures designed to reduce collisions for new drivers in a scheme called graduated driver licensing system. The purpose of graduated licensing is to allow novice or young drivers to obtain driving experience away from the major causes of collisions, such as alcohol (e.g., Mayhew and Simpson, 1990). Research in jurisdictions which have introduced graduated licencing or similar restrictions on young or novice drivers demonstrates, on balance, important reductions in collisions and injuries due to the introduction of the measures (Jones, 1994; Mayhew and Simpson, 1990).

New Zealand was the first jurisdiction to introduce a comprehensive set of licensing restrictions under the umbrella term of graduated licensing for new drivers. Initial reports from New Zealand, following the introduction of a graduated licensing system, were that injury crashes among all drivers dropped by 12%, while injury crashes among 15 to 17 year olds (those most affected by the system) dropped by 40% (Sweedler and Stewart, 1993). More formal evaluations of specific impacts of Graduated Licensing in New Zealand on young drivers were reported by Frith and Perkins (1992) and Langley, Wagenaar and Begg (1996). Frith and Perkins (1992) compared aggregated collision rates of young drivers (aged 15-19) who would be most affected by the system to those of older drivers who would be least affected (aged 25 and older). Substantial reductions specific to the younger age group were observed on several measures of collision involvement and injury rate. It also appeared that the number of young drivers seeking licensing also dropped substantially, and Frith and Perkins (1992) concluded that the beneficial effects observed were primarily due to reduced exposure. Langley et al. (1996) conducted time series analyses of the New Zealand experience, and reached identical conclusions. These authors report a reduction in car crash injuries of 22.9% in the 15-19 age group. However, they note that older drivers also experienced injury reductions at the same time (e.g., 15.6% for the 25 and over age group) and suggest that the actual impact of graduated licensing was somewhere between a 7% and a 25% reduction in injuries for the 15-19 age group.

These analyses of the New Zealand experience do not allow any inference of the specific effect of the 0 BAC limit. Research on the effects of raising the drinking age in the U.S. is relevant here because it was a legal measure designed in large part to reduce alcohol-related

collisions among youth, and because much research on the effects of this measure on collision rates in affected young people has been reported. Reviews of this research unanimously indicate that drinking age increases are associated with reductions in drinking-driving fatalities and crashes in affected age groups (e.g., U.S. Government Accounting Office, 1987; Vingilis and DeGenova, 1984; Wagenaar, 1983; Williams, 1986). However, the reason for these reduced collisions and fatalities remains unclear, and others have suggested that effects attributed to raising the drinking age have been overstated (Mayhew and Simpson, 1990).

More recently, several Canadian jurisdictions have introduced a graduated licensing system. Initial evaluations of Ontario's experience with the 0 BAC limit have been reported by Mann et al. (1997b). These investigators surveyed students in grades 11 and 12 with a driver's licence in seven secondary schools in Ontario, before and after the introduction of a graduated licensing scheme in 1994. They observed significant reductions (25%) in the proportion of male drivers who reported driving after drinking at any time in the previous year. Interestingly, they did not observe any impact on female drivers, nor did they observe any impact on the frequency of drinking-driving among drinking-drivers. They also noted that there appeared to be a reduction in the number of the licensed drivers in affected age groups, suggesting that beneficial impacts of graduated licensing in Ontario could be due both to specific behavioural changes (reduced driving after drinking) as well as reductions in driving exposure (fewer drivers in affected aged groups).

Effects of Reducing a Legal limit to 50 mg% or Lower for All Drivers

In several jurisdictions, a legal limit of 50 mg% or lower has been introduced. Several evaluations of theses measures have been reported. It is important to keep in mind, when considering this work, that these evaluations differ substantially in methodological rigour, ranging from inspection of trends in a relatively small geographic area to rigorous statistical analyses of the impact in a large jurisdiction such as a state or nation. In regard to using this work to estimate the likely impact in Canada, more weight should be placed on the more rigorous research studies.

***Ontario*:**

In 1981, Ontario amended the Highway Traffic Act to introduce a 12-hour roadside licence

suspension for drivers who registered 50 mg% or more on a roadside screening device or evidentiary breath tester (Vingilis, Blefgen, Lei, Sykora and Mann, 1988). The law was introduced December 17, 1981. In an evaluation of this law, Vingilis et al. (1988) tested a systems model of deterrence, where a successful deterrent effect of a new law required completion of several intermediate steps. These intermediate steps included publicity, education and enforcement which in turn generated increased knowledge and awareness of the law and increased perception of the risk of being caught if driving while drunk. Successful achievement of these conditions were hypothesized to result in a decrease in driving after drinking, followed by a reduction in alcohol-related fatalities. Vingilis et al. (1988) thus were particularly interested in these intermediate steps in the model. They noted that data on the intermediate steps suggested that many of the preconditions for a successful deterrent effect may not have been met, or were only partially met. For example, there was no organized public education campaign, media coverage was limited, and many police forces were not equipped to enforce the new law until a substantial length of time after it was introduced. Time series analyses were employed to examine the impact of the measure on the monthly log odds of motor vehicle fatalities having a positive BAC. Introduction of the measure suggested a significant reduction in alcohol-involved fatalities. Further confirmation of a beneficial effect specific to the introduction of the law was obtained from an analysis of a control time series from Saskatchewan and Manitoba in which no significant effects were observed. However, the impact appeared to be short-lived, and had largely disappeared after several months.

***Australia*:**

Several states in Australia have reduced their legal BAC limit to 50 mg%. Queensland lowered the legal limit from 80 to 50 mg% in 1983. The impact of this change was assessed by Smith (1986), who compared the BACs of collision-involved drivers in the years before and after the introduction of the law. Smith observed significant reductions in the numbers of collision involved drivers who had been drinking. These reductions were higher at higher BACs (reduction of 12% at BACs above 150 mg%) than at lower BACs (reduction of 8% at BACs between 80 and 150 mg%).

In South Australia, the legal limit for all drivers was lowered from 80 to 50 mg% on July 1, 1991. The impact of this change was evaluated by Kloeden and McLean (1994). These authors examined data from roadside breath alcohol surveys carried out in Adelaide, South Australia. These surveys were conducted using similar methodologies in 1987, 1989, 1991 (prior to introducing the 50 mg% limit), 1991 (following introduction of the 50 mg% limit) and 1993. The surveys focussed on late night driving (between 10 p.m. and 3 a.m.). A significant reduction in drinking and driving was observed in comparing the 1991 pretest to the 1991 posttest, and these reductions increased to the 1993 posttest. Overall, the authors noted a decline of 14.1% overall in the proportion of drivers who were BAC positive from the 1991 pretest to the 1993 posttest. This decline was more marked when the authors considered only the proportion of drivers who were over 50 mg% (reduction of 32.7%) and even more pronounced when they considered the proportion of drivers who were over 80 mg% (reduction of 38.2%). While these results are very encouraging, interpretation is limited by the various threats to validity of the simple pretest-posttest design (Campbell and Stanley, 1967). The authors note that interpretations of these data could not yet be conclusive, because of the possible operation of other factors such as the introduction of random breath testing or to general changes in social attitudes.

In a subsequent report, McLean, Kloeden, McColl and Laslett (1995) compared the roadside survey data to BACs of fatally injured drivers in Adelaide. In this report, McLean et al. (1995) comment that the reduction in the percentage of late night drivers with high BACs appeared to be only temporary. They also noted that there appeared to have been a drop in the proportion of fatally injured drivers who had a BAC of 80 mg% or higher. They also noted that it was difficult to specify changes were due to the legislation because there appeared to be long-term trends in the measures. However, no statistical analyses were reported to support the authors' claims.

Brooks and Zaal (1993) evaluated the impact of the reduction of the legal limit in the Australian Capital Territory from 80 to 50 mg% on January 1, 1991. These authors examined several indicators of impact, including the recorded BACs of breath-tested drivers and crash-involved drivers. In comparing data from the year prior to the introduction of the law to data from the year following its introduction, BACs of tested drivers declined significantly. This effect became more

pronounced as BAC levels increased; the declines among drivers with BACs below 150 mg% (-9% and -11% for drivers in the ranges 80-99 and 100-149 mg % respectively) were not statistically significant, while the declines among drivers at higher BACs were highly significant (-34% and -59% for drivers in the ranges 150-199 and 200 and above, respectively). Additionally, the same pattern was observed among collision-involved drivers. These data suggest that the effects of this law were not restricted to drivers in the narrow BAC range affected, but instead exerted a very substantial effect for drivers at the highest BACs.

More recently, the impact of several drinking-driving countermeasures, including the introduction of 50 mg% limits, has been evaluated for the Australian states of New South Wales and Queensland (Henstridge, Homel and Mackay, 1997). These authors applied rigorous time series methods to daily collision data (serious and fatal collisions) for time periods which began as early as 1976 and ranged up to 1992. The analyses controlled for seasonal effects, daily weather patterns, indices of economic and road use activity, alcohol consumption and day of the week. The authors examined the impact of these measures on all collisions, not just alcohol-related collisions, because of lack of consistent availability of BAC data. The results indicated a significant and continued impact of the 50 mg% law. In New South Wales, the 50 mg% law was estimated to have reduced all serious collisions by 7%, fatal collisions by 8% and single-vehicle nighttime fatal collisions by 11%. The numbers of collisions of these three types prevented per year were estimated to be 605, 75 and 296, respectively. Similarly, in Queensland the 50 mg% limit was estimated to reduce all serious collisions by 14% and fatal collisions by 18%. Collisions prevented per year of the two types were estimated to be 599 and 91, respectively. In these analyses the impact of other measures has been statistically removed. For example, the introduction of Random Breath Testing in these states was observed to exert a strong and beneficial impact on collision rates, and this impact has been statistically removed from the impact of the 50 mg% limit.

***Sweden*:**

In Sweden, the legal limit was lowered from 50 mg% to 20 mg% on July 1, 1990. Norstrom and Laurell (1997) evaluated the impact of this change with rigorous time series

analyses, similar to those employed by Vingilis, Blefgen, Lei, Sykora, and Mann (1988) and Henstridge, Homel, and Mackay (1997). Also, similarly to Henstridge et al. (1997), they did not examine the effects of this measure on alcohol-related collisions because of variability in the availability of accurate measures of alcohol-involvement in particular collisions, but instead selected measures of fatal collisions, single vehicle collisions, and all collisions for examination. Their time series data consisted of monthly data from July, 1987 to June, 1996, and included in their model were control series for alcohol consumption and miles driven. Their results were also very similar to those reported by Henstridge et al. (1997). Specifically, they observed significant reductions in fatal collisions, single vehicle collisions and all collisions of 9.7%, 11% and 7.5%, respectively. They caution that the age distribution of drivers has changed somewhat, and estimate that this change could have accounted for about a third of the reduction in fatal collisions. This would reduce the impact on fatal collisions to about 6%. Norstrom and Laurell (1997) also examined the BAC distribution of convicted drinking-drivers in Sweden before (1987) and after (1991) the 20 mg% limit was introduced. They observed that the average BAC declined from 168 mg% to 154 mg%. The distribution of BACs in this group also appeared to shift, with a larger percentage being under 150 mg% and a smaller percentage being at 150 mg% and above. The largest reductions came at the highest BAC levels. Drivers at 250 mg% and above declined from 13.1% in 1987 to 8.5% in 1991.

***France*:**

France reduced its legal limit from 80 mg% to 50 mg% in 1996. As of yet, no formal evaluation of the national impact of this limit has been undertaken. However, recently Mercier-Guyon (1998) has presented some preliminary pre-post comparisons on the impact of the 50 mg% limit in the French province of Haute-Savoie. He notes that there appear to be reductions in alcohol-involved fatal and injury collisions following the introduction of the law. Specifically, total fatalities involving a drinking-driver declined from about 100 per year in the years preceding the introduction of the law (1993,1994 and 1995) to 64 in 1997. However, the effect seems to have been delayed for unknown reasons or may involve factors additional to the introduction of the 50 mg% limit, since the 1996 data (the first year of operation of the 50 mg% limit) seemed to

be unaffected (111 deaths). Mercier-Guyon (1998) suggested that the impact of this measure was more pronounced for drivers at higher BACs (over 80 mg%) than for drivers in the 50-80 mg% range.

Summary:

Table 12 summarizes studies evaluating a reduction of the legal BAC limit to 50 mg% or lower. The characteristics of the research, and the experiences with this measure, appear to be very similar to those noted for evaluations of the introduction of legal limits, lowering them to 80 mg%, and lowering them for new or young drivers. In interpreting the results, it is important to keep in mind that, due to the limitations involved in carrying out research on naturally occurring legal changes, each individual study reported here is subject to potential confounding factors. Those studies which report simple pre-post differences (e.g., Kloeden and McLean, 1994; McLean et al., 1995; Smith, 1986) are most subject to the confounding effects of such factors as simple historical trends. However, even research employing sophisticated time series analyses, which would control for the effects of simple changes over time (e.g., Henstridge et al., 1997; Norstrom and Laurell, 1997), may under some circumstances be influenced by such factors as the occurrence of an economic recession. Overall, it appears that beneficial effects on alcohol-related collisions, injuries and/or fatalities have been observed in every jurisdiction in which a reduction of the legal limit to 50 mg% has been evaluated. Again, though, variable findings emerge (cf., Kloeden and McLean, 1994; McLean et al., 1995). As noted, the quality of the observations ranges from simple pre-post designs or observations of trends (e.g., Smith, 1986) to statistically rigorous time series evaluations controlling for potential confounding factors (Henstridge et al., 1997; Norstrom and Laurell, 1997). These variable results, then, may be related to methodological differences between studies, as well as to differences in measures used and the social and historical background. As well, in some cases it appears that beneficial effects may decline over time (McLean et al., 1995; Vingilis et al., 1988), but lasting reductions in alcohol-related collisions and fatalities have been observed (Henstridge et al., 1997; Norstrom and Laurell, 1997).

Table 12. **Summary of Research Evaluating the Impact of the Reduction of the Legal BAC Limit to 50 mg% or Below**

Location	Authors	Measures	Design/ Analysis	Impact
Ontario; Introducing the 50 mg% 12-hour suspension provision of the Highway Traffic Act	Vingilis et al., 1988	Proportion of fatal collisions involving alcohol, plus various secondary measures of awareness, impact and enforcement of the law	Time series analysis	Introduction of the 50 mg% HTA provision had significant but apparently temporary impact on alcohol-related collisions, perhaps due to lack of awareness and enforcement
Queensland, Australia; Reduction of the legal limit from 80 to 50 mg% in 1983	Smith, 1986	Collisions involving drinking drivers	Pre-post comparison	Reduction of the limit to 50 mg% resulted in a significant reduction in numbers of collision-involved drivers who had been drinking
Australian Capital Territory, Australia; Reduction of the legal limit from 80 to 50 mg% in 1991	Brooks and Zaal, 1993	Several indicators of drinking driving and alcohol involvement in collisions	Pre-post comparison	Reduction of the limit to 50 mg% resulted in a significant reduction in the BACs of collision-involved drivers who had been drinking, and in the BACs of drivers breath-tested by police
Adelaide, Australia: Reduction of the legal limit from 80 to 50 mg% in 1991 in South Australia	Kloeden and McLean, 1994	Distribution of BAC's among drivers	Pre-post comparison	Reduction of the limit to 50 mg% resulted in a significant reduction in the BACs of drivers breath tested in roadside surveys
Adelaide, Australia; Reduction of the legal limit from 80 to 50 mg% in 1991 in South Australia	McLean et al., 1995	Distribution of BACs in fatally-injured drivers and drivers tested in roadside surveys	Pre-post comparison	Reduction of the limit to 50 mg% resulted in a temporary reduction in the BACs of nighttime drivers and a reduction in the proportion of fatally injured drivers with BACs over 80 mg% - No statistical analyses reported
New South Wales and Queensland, Australia; Reduction of the legal limit from 80 to 50 mg%	Henstridge et al., 1997	Numbers of serious collisions, fatal collisions and single vehicle nighttime collisions	Time series analyses	Reduction of the limit to 50 mg% resulted in significant reductions in all collision and fatality measures in both states
Sweden; Reduction of the legal limit from 50 to 20 mg%	Norstrom and Laurell, 1997	Numbers of fatal collisions, single vehicle collisions and total collisions	Time series analyses	Reduction of the limit to 20 mg% resulted in significant reductions in all collision and fatality measures
France; Reduction of the legal limit from 80 to 50 mg% in 1996	Mercier-Guyon, 1998	Numbers of fatalities involving a drinking driver in Haute-Savoie	Pre-post comparison	Reduction of the limit to 50 mg% was associated with a decline in the numbers of fatalities involving a drinking driver; no analyses reported

Who is influenced when legal BAC limits are changed?

It was noted earlier that drivers in the lower BAC ranges, including those who would be affected if the limit were lowered from 80 to 50 mg%, constitute a relatively small proportion of impaired drivers and are responsible for a relatively small proportion of alcohol-related collisions, injuries and fatalities. It clearly follows from the relative risk data that drivers at higher BACs, who are more likely to be involved in collisions than drivers at lower BACs, constitute a higher proportion of the drinking-driving problem. These high BAC drivers need to be a continuing focus of countermeasure efforts (e.g., Simpson and Mayhew, 1991; Simpson, Mayhew and Beirness, 1996). With this in mind, it is reasonable to question the wisdom of a measure which, if implemented, would appear to target those drivers who are responsible for a minor share of alcohol-related collisions. An important question to consider, then, is whether the impact of lowering a BAC is specific to drivers in the affected BAC range, or whether there is evidence of more general effects (general deterrence) on drivers at other, and particularly, higher BAC levels.

The research described above has addressed this issue and will be summarized here. Most studies that have examined the impact of a reduction in driver BAC levels, or BAC levels in fatally injured drivers, have observed a substantial impact on BAC levels other than those affected by the change in limits. This effect has been observed generally (Transportation Research Board, 1987; Hingson et al., 1996) and also specifically when the legal limit has been lowered to 50 mg%. In Adelaide (South Australia) (Kloeden and McLean, 1994), the Australian Capital Territory (Brooks and Zaal, 1993) and Sweden (Norstrom and Laurell, 1997) it appeared that introduction of a 50 mg% limit or a reduction of the legal limit to 50 mg% or less acted most strongly to reduce the proportion of drivers with the highest BACs, e.g., 150 mg% or more, among those surveyed at the roadside, arrested, or fatally injured. However, one study (McLean, Kloeden, McColl and Laslett, 1995) did suggest that some of the initial effects wore off with time.

Overall, then, these observations suggest that lowering the legal limit may have a broad deterrent effect on all drinking-drivers, and may exert its strongest effect on those at higher BACs. The hardcore or high BAC driver has recently and deservedly been the focus of many countermeasure efforts (e.g., Simpson and Mayhew, 1991; Simpson, Mayhew and Beirness,

1996). It would appear from the research examined here that a reduced BAC limit may be an effective means to reduce the problems caused by this group.

Conditions for Successful Legal Initiatives

The major impact hoped for with a reduced BAC limit is a general deterrent effect, where people who might otherwise drink and drive are deterred from doing so by knowledge of the law and the consequences of violating it (Homel, 1990; Vingilis, 1990). As noted above, many previous studies have demonstrated that the introduction of new drinking-driving laws or policies can have a substantial general deterrent effect if they are introduced under the correct conditions. The classic example is Ross' (1973) analysis of the impact of the British Road Safety act in 1969. He observed, initially, a significant and marked decline in collisions most influenced by alcohol (single vehicle nighttime collisions). However, the collision rate appeared to return to pre-law levels after about a year.

Various authors have suggested that this initial impact is due to an increase in perceived risk of being caught that is caused by the high level of publicity associated with new legal sanctions, while the decline is due to the realization that the actual risks of apprehension are not as high as initially believed (e.g., Homel, 1990; Ross, 1973; Vingilis, 1990). Similar patterns of impact of new legal measures have been observed in other jurisdictions (e.g., Homel, 1990), including the effect of the 12-hour suspension law introduced in Ontario in 1983 (Vingilis, Blefgen, Lei, Sykora and Mann, 1988).

Homel (1990) argued that continued high publicity/public education efforts and high levels of enforcement by police will maintain the public's perceived risk of apprehension and thus result in a more pronounced deterrent effect of such laws. He evaluated this hypothesis in examining the effects of Random Breath Testing (RBT) in Australian states (Homel, 1990). In New South Wales, RBT was introduced under high impact conditions, i.e., with sustained public education and high profile enforcement efforts. Under these conditions, lasting collision reductions were observed, and Homel (1990) estimated that alcohol-related collisions were reduced by 30% on what appeared to be a permanent basis. However, in other states RBT was not introduced with such intensity in either education or enforcement efforts, and similar sustained collision reductions

were not observed (Homel, 1990). It is unclear whether the population has become desensitized to the educational message.

As noted, although the impact of legal measures on collisions, injuries and fatalities is generally positive, variability has been observed. This variability may result from differences in the public education measures surrounding the new laws. As discussed above, the general deterrent impact of new laws and other countermeasures appears to depend on the public's awareness of them as influenced by a variety of factors including the visibility with which they are enforced (Ross, 1973; Vingilis and Salutin, 1980; Mercer, 1985; Homel, 1990, Vingilis, 1990). In at least one previous instance, the collision-reducing potential of a new drinking-driving law in Ontario may have been muted by low levels of public awareness (Vingilis et al., 1988). That is, in order for drivers to modify their behaviour, they must be made aware of the new law through public education and high visibility enforcement.

Chapter 5
POTENTIAL COSTS AND HARMS OF LOWERING THE LIMIT

Very little research exists on potential negative aspects of lowering the legal BAC limit in general, and specifically from 80 mg%. One factor that could influence the likelihood of negative impacts is acceptance of any new legislation. If a new law is regarded as too severe by many police or judicial authorities, then differential enforcement and judicial practices could arise. Furthermore, if the general public does not agree with new legislation then it may have little deterrent value.

Police Practices

Results from an early survey of police officers in Ontario concluded that some police officers view drinking and driving as a folk crime and not a serious criminal offence (Vingilis et al., 1986). Such attitudes might translate into relaxed enforcement practices. Lowering the legal BAC limit could further exacerbate this problem. However, a more recent survey suggests some changes in police attitudes over time. Jonah, Yuen, Arora, Theissen, Paterson, Pilon and Graham (1997) surveyed police officers across Canada. They observed that the police ranking of the priority of impaired driving has increased since Vingilis et al.'s (1986) survey, and was ranked fifth after murder, sexual assault, kidnapping and robbery. However, they noted that officers do not believe that they have adequate resources now to deal with drinking-drivers. They found a relatively low level of support for lowering the legal limit to 50 mg% (36.6% of all officers surveyed), and officers appeared to favour administrative measures over changes to the Criminal Code. Administrative measures typically require less time to enforce, particularly on the part of police, than is currently required for Criminal Code charges. Jonah et al. (1997) found that police officers reported an average of 2 hours and 48 minutes to process each DWI charge, and that the average length of a DWI trial is over 4 hours.

Another aspect of police enforcement related to lowering the legal BAC limit is the degree to which the police can effectively enforce the law. Low enforcement of the law is related to inadequate manpower, time consuming arrests, attitudes of enforcers, and paper work (Vingilis et

al., 1986). The average police arrest for DWI requires a great deal of time, when paperwork and court time are considered. Similar reasons for poor enforcement of existing DWI laws have been documented by others (Hurst, 1980; Jonah and Wilson, 1983; Jonah et al., 1997).

Police discretion in terms of arresting DWI offenders occurs for many other reasons. Hurst (1980) discovered that police were more likely not to arrest a drinking-driver if another sober driver was in the car who could drive. Similarly, cooperative drivers were less likely to be arrested than non-cooperative ones. Hurst (1980) suggested that the ultimate reasons for such discretion were likely related to the fact that 23% of the officers surveyed felt the consequences of arrest for DWI were too severe. Jonah et al. (1997) found that 31.1% of police surveyed sometimes or frequently used discretion in laying charges, by arranging a taxi or ride or having a sober passenger drive. Also, 17.5% of officers reported personally using short-term roadside suspensions at least sometimes instead of laying Criminal Code charges. The impact of such police discretion may result in a gradual erosion of the deterrent value of per se laws.

An additional consideration in lowering the legal limit would be the impact it might have on existing enforcement practices. For example, in British Columbia, roadside suspensions outnumber Criminal Code charges by about 4 to 1 (Mercer, personal communication). The paperwork and time required for these brief suspensions is much less than that required for a Criminal Code charge, and thus police are able to process a larger number of drivers when they employ roadside suspensions. If police are required to lay a Criminal Code charge instead of issuing a roadside suspension, the amount of high visibility spot-check activity could decline with a corresponding adverse impact on traffic safety.

The Judicial Process

Aside from discretion that can occur at the level of enforcement, a proportion of those arrested for DWI ultimately are not convicted. Certainty of conviction is believed to be related to the deterrent effect of a law (Ross, 1984; Vingilis, 1990). In Canada, the conviction rate for drinking-driving offences is generally quite high (Vingilis et al., 1986). Although the per se laws introduced in 1969 were designed to make convictions easier, this goal may have been eroding over time. Defence lawyers have been successful in challenging testing procedures to obtain

discharges. As well, there is a perception that cases are being successfully plea bargained to a lesser charge, even though the police officers surveyed by Jonah et al. (1997) reported that 90% of individuals charged with an impaired driving offence ultimately are convicted. A lower legal BAC limit might affect the proportion of those arrested who are not convicted and lead to unevenness in how cases are handled. Some crown prosecutors feel that it has become more difficult over time to prosecute cases involving BAC evidence. Coupled with this, the recent introduction of drug recognition officers (police officers specially trained to recognise symptoms of various drugs, including alcohol) in some provinces may lead to an increase in prosecution of the impaired driving offence without BAC evidence.

Another factor to consider is the capability of the justice system to accommodate increased numbers of DWI offenders. If the legal BAC limit is lowered, more cases may need to be processed, which could put an increased strain on the police and courts, which in turn, could lead to fewer convictions. Mercer (personal communication) has estimated that increased cases resulting from a reduction in the legal limit to 50 mg% could add an additional $40,000,000 to court costs (excluding penal costs) in Canada.

Public Attitudes and Impact on Individuals

Public acceptance of a new lower BAC limit is also important in terms of having a potential impact on alcohol-related collisions. Public acceptance of existing per se laws has likely increased over the past two decades, along with increased public awareness of the magnitude of the drinking-driving problem, support for action on these problems, and changes in behaviours and attitudes. These changes in attitudes are frequently credited to such factors as increased educational campaigns, media coverage and police enforcement (e.g., Beirness, Simpson, Mayhew, Wilson, 1994; Wilson and Mann, 1990). Public attitudes towards a lower legal limit may influence public attitudes to drinking-driving countermeasures in general. One recent survey (COMPAS, 1997) observed that, while 60% of the general public in Canada either supported or strongly supported a reduced legal limit, the level of support for other measures such as greater enforcement of the law and random breath testing was higher.

The public may be reluctant to accept a new lower limit. Although many people may agree

their performance at a BAC of 50 mg% is reduced, they may not agree that it is reduced enough to warrant a criminal charge. Others might feel that their driving performance is not significantly affected at these levels. Consequently, a proposed lowering of the legal BAC limit may be opposed by some people because they might not view driving with a BAC of 50 mg% as dangerous and morally wrong. In Sweden, it was reported that when the legal BAC was reduced, the public became less negative toward DWI offences (Aberg, 1995, Clayton, 1997). Such perspectives could adversely influence any beneficial impact of a reduced BAC limit.

One final harm that should be considered of legislation under the Criminal Code is the impact of criminalization on a substantial group of people who otherwise would not have a criminal record. A criminal record can affect an individual's life through restriction for some types of jobs or restricted travel. Therefore, consideration should be given to whether the costs of such measures outweigh the benefits, or whether similar effects could be achieved with less punitive measures.

Chapter 6
DISCUSSION AND CONCLUSIONS

This report is based upon a review of published literature, in a wide range of subject areas, and of research often not specifically designed to address the question at hand. Therefore the conclusions drawn from such an overview are necessarily cautious. As is always the case when research on the likely impact of specific policies is considered, most of the questions involved are not amenable to a direct test under ideal conditions, and instead must be examined under conditions which do not readily lend themselves to a rigorous experimental design. Laws and policies are often introduced by governments in response to political concerns, and evaluation of their impact is at best a secondary concern. As well, the results of individual studies must be treated with caution, because a variety of (often unknown) factors may be influencing the results. Instead, it is important to look for convergence of results from a variety of different studies. A specific confounding factor may cause an incorrect interpretation of a single study, while a variety of studies, carried out under different conditions, which lead to similar conclusions inspire greater confidence in the interpretation. What follows is a summary of the major findings of this review with respect to specific questions about issues in reducing the legal BAC limit in Canada to 50 mg%.

Are drivers impaired at BACs in the 50-80 mg% range?

The experimental research is conclusive that some level of impairment of skills relevant to driving occurs at BACs between 50 and 80 mg%. Laboratory studies demonstrate that functions such as visual acuity and divided attention are significantly impaired by doses of alcohol leading to BACs of 50 mg% or less. Performance on driving tests similarly demonstrates this impairment; however, variability among individuals is observed in all of these studies and some individuals are more impaired than others in this BAC range. It is clear that level of impairment of many skills necessary for driving increases with increasing BAC. What is more difficult to define or at least to quantify from these studies is the degree of excess risk implied by these levels of impairment.

Are drivers with BACs between 50 and 80 mg% more likely to be involved in collisions?

Epidemiological research on collision-involved drivers indicates that there are significant increases in risk of collisions at BACs in the 50-80 mg% range; it currently appears that increases in risk of collisions begins at low BACs and increases thereafter. There appears to be some variability between studies in estimates of the average increase in collision risk for drivers in that BAC range, with published estimates ranging from one and one half to ten times more likely to be involved in a collision. As well, the increase in risk may differ according to such factors as driver age, drinking practice, and collision type. It is clear that collision risk is increased at these BAC levels, although the risk of collision is greater at 80 mg% than at 50 mg%.

Is a 50 mg% legal BAC limit an unusual or rare policy?

The first BAC limit defined under a per se law was 50 mg% in Norway. Since then, many countries have introduced 50 mg% limits, and some have lower legal limits. Sweden has a limit of 20 mg%, and the U.S., while currently working to have a uniform 80 mg% limit for all states, has a 40 mg% limit for commercial drivers. There already exists in most Canadian provinces a minor sanction applied to drivers at levels below 80 mg% under the provincial highways acts.

It is worth noting that, in jurisdictions that have lowered the legal limit to 50 mg% or less, some form of tiered approach to penalties as a function of BAC has typically been adopted. This can be seen in several Australian states (Table 9). For example, in Victoria, conviction with a BAC of 50-100 mg% leads to a six-month license suspension. A BAC of 100-240 mg% leads to a one month suspension for every 10 mg%, and a BAC over 240 mg% results in a 24 month suspension. The situation in Canada currently approaches a tiered policy, when the provincial sanctions for BACs under 80 mg% are considered in combination with the Criminal Code offences.

Can levels of drinking-driving and alcohol-related collisions be reduced by legal means?

Legal measures are central to modern efforts to reduce the toll of injuries and fatalities caused by drunk drivers. Evaluation of many legal initiatives reveal at least temporary reductions in collisions, fatalities and injuries as a result of their implementation. More recently, lasting

beneficial effects have been demonstrated. While it cannot be demonstrated with certainty, a widely-held belief in the research community is that legal measures, such as the introduction of per se laws, have been a key factor in the reductions in drinking-driving fatality rates observed in many countries since the early 1980s. Public awareness, public support and high profile enforcement are also crucial to maximizing the impact of legal measures.

Has the introduction of a 50 mg% legal BAC limit (or lower) in other jurisdictions had an impact on alcohol-related collision rates?

Several evaluations of the introduction of a 50 mg% legal limit have been reported. The majority of evaluations have observed a beneficial impact on collision rates, and subsequent injuries and fatalities. In some instances the results have been less conclusive. However, in studies employing the most rigorous data collection and analytic techniques, significant beneficial effects have been observed. Although the number of studies which report data in a manner which permits estimation of the percent reduction in fatal collisions resulting from this measure is limited, the reported reductions in total fatalities or fatal collisions have ranged from 6% to 18%. In Canada in 1996, there were a total of 3,082 motor vehicle collision fatalities (Jonah, personal communication). Applying the percentage reductions reported for other jurisdictions (specifically, Norstrom and Laurell's [1997] and Henstridge et al.'s [1997] estimates of reductions in fatal collisions of 6% and 18% in Sweden and Queensland respectively) to Canada, a 50 mg% legal BAC limit could prevent between 185 and 555 motor vehicle fatalities per year. The impact on injuries would be substantially larger, although more difficult to estimate. However, these figures likely represent an upper limit to any beneficial effects that might be observed. It is very possible that the impact would be much smaller, particularly if the limit were reduced without efforts to increase public awareness of, and support for, a reduced limit and if the police did not have the resources to mount high-profile enforcement initiatives. Thus, while the potential for benefit is clear, it is unknown whether the beneficial impact seen in other jurisdictions is replicable in Canada.

Is the impact of reducing the legal BAC limit from 80 to 50 mg% restricted to drivers at those BAC levels?

Research suggests that where positive effects of introducing a 50 mg% limit have been observed, those effects have not been limited to drivers in the affected BAC range. Instead, in the majority of studies, an impact on all impaired driving seems to be observed, suggesting a broad general deterrent effect.

Would there be any harm or negative consequences of introducing a 50 mg% per se BAC limit to Canada's Criminal Code?

The answer to this question is yes; however, the degree to which those adverse effects can be expected, or even what harm is likely to occur, is unclear. Certainly, the potential impact on the criminal justice system in terms of increased demand on police and court resources needs to be taken into account, in addition to the potential economic and other harms to individuals who are convicted. Any potential reduction in police enforcement of the drinking-driving laws, which might occur if the law is perceived as being too severe, could have an adverse impact on overall traffic safety. Similarly, a reduction in conviction rates or an increase in 'not guilty' pleas could create serious problems in the courts, as well as adversely influence traffic safety. As well, if the law is introduced during a time when the large majority of the public are opposed to it, unforeseen consequences for enforcement or compliance could develop.

There will be concerns about damage to economic interests. Although some investigators have suggested that there appeared to be no significant impact on alcohol consumption and sales of such a measure (e.g., Mercier-Guyon, 1998), there appears to be no large scale investigation that has been conducted of the economic consequences of a 50 mg% per se law. Certainly, potential economic damage must be weighed against the potential reductions in collisions, injuries and fatalities, but available research does not inform us as to the relative balance of these.

Are there factors which would increase or decrease the potential impact of a 50 mg% limit?

Previous research does demonstrate conditions under which the introduction of a law such as this one will be maximized or minimized. To maximize the impact of a measure such as a 50

mg% limit, the public must be aware of the introduction of the law, perceive that it will be (or is being) enforced, and perceive that they have a strong chance of being apprehended if they break the law. As well, police need the resources to carry out high visibility enforcement efforts. Additionally, while Parliament creates provisions in the Criminal Code, prosecution is the responsibility of the Attorneys General in each province. Thus the degree of support for a reduced legal limit by provincial governments is also a very important consideration.

Will existing provincial 50 mg% laws influence any impact of a Criminal Code change?

Research provides no definite answers to this question. The only evaluation of these provincial initiatives was the evaluation of the introduction of Ontario's 12-hour suspension regulation in 1981. Vingilis et al. (1986) noted that the law appeared to have a modest beneficial effect; however, that effect had disappeared after a few months. No other evaluations of these regulations have been reported. In general, the differential impact of criminal versus other kinds of laws and regulations (provincial or administrative) is unknown. Many factors would likely influence any impact of the introduction of a 50 mg% BAC limit in the Criminal Code (see the preceding section), one of which is the current provincial regulations. Certainly if the public perceives no fundamental change in the drinking-driving laws with the introduction of a 50 mg% BAC limit to the Criminal Code, e.g., if they perceive the change as simply the replacement of provincial laws with a federal law, any impact of the law is likely to be minimized. However, if the public perceives important changes occurring which will apply to them, e.g., increase their perceived likelihood of being apprehended or of the seriousness of the crime, then the impact of the legal change will be maximized.

The situation may be analogous to the original introduction of the per se laws in Canada and other jurisdictions. While laws against drunk driving were previously in place, introduction of the new law, particularly where public perceptions of the likelihood of being apprehended where increased, had a significant beneficial impact on road safety. A more recent parallel may be the introduction of Administrative License Suspensions (ALS) in many jurisdictions such as Ontario and Manitoba. In the U.S., ALS was originally devised as a means to ensure that drunk drivers received some form of license suspension since courts often did not assign license suspensions as

a penalty. However, in Manitoba and Ontario ALS is an 'add-on' to existing license suspensions which are already administratively assigned (i.e., by the licensing authority rather than the courts). Even under these circumstances, the impact of ALS appears to be significant when introduced under appropriate conditions (e.g., Beirness, Simpson, Mayhew and Jonah, 1997; Mann, Smart, Xie, Adlaf, Bondy and Ivis, 1997a).

Concluding Comments

The central purpose of the review is to determine whether or not the experiences of other jurisdictions in introducing a legal limit of 50 mg% or lower are sufficiently consistent to predict what the experience in Canada might be if this step were taken. In every jurisdiction in which a 50 mg% limit has been introduced, there is at least some evidence of beneficial effects, in terms of reduced collisions, injuries and fatalities. Thus in Canada, the introduction of a 50 mg% legal limit has the potential to produce important health and economic benefits which would result from a reduction in alcohol-related collisions.

However, additional factors need to be kept in mind when considering such an action. In particular, the broader context within which a new legal limit is introduced would act to either increase or decrease any benefits that might be observed. Thus, these contextual factors, including levels of public and political support for a reduced BAC, must also be assessed, as must the willingness to introduce such a measure with the resources which appear necessary for its success.

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Appendix A

Summary of the Survey of Members of the International Council on Alcohol, Drugs and Traffic Safety

The first stage in this review was to identify and obtain the available literature relevant to the topic. A comprehensive search of computerized databases was therefore undertaken. However, it was thought likely that much relevant literature may be too recent to be on these databases, or is available only in limited-circulation reports of government and non-government agencies. To identify and obtain this information, a survey was conducted of the membership of the International Council on Alcohol, Drugs and Traffic Safety (ICADTS), an international association of researchers and policy makers in the field of alcohol, drugs and traffic safety.

The survey asked members for their knowledge of the legal limits in various jurisdictions so a comprehensive listing could be prepared, as well as their knowledge of, and the availability of, any reports which evaluate a 50 mg% BAC limit in any jurisdiction or which evaluate the collision risks associated with driving after drinking, and in particular at BACs between 50 and 80 mg%. The survey was mailed out in August, 1997 and follow-ups were conducted at the ICADTS conference in September, 1997. Of the 121 survey recipients 25 were able to provide specific information including BAC levels and published and unpublished research.

Letter Mailed to ICADTS Members

Dear colleague:

We are presently reviewing, for Transport Canada, studies on the potential impact of changing the legal Blood Alcohol Limit in Canada from 80 mg% to 50 mg%. We are therefore contacting members of ICADTS and other members of the road safety community to identify relevant information, especially reports that would be difficult for us to access through a review of the published literature. Examples of these are limited-circulation reports written by government and non-government organizations, or research on computer databases. We are also interested in what are the legal blood alcohol limits in various countries or states within countries. In order to identify and obtain this information we would very much appreciate your participation in completing the attached brief survey.

My colleagues and I would be very grateful if you could return the survey to us in the envelope provided as soon as is convenient for you. Alternatively, you can forward information to me by fax at 416-595-6899, or by e-mail at rmann@arf.org. Your participation will be acknowledged in the final report. Thank you very much for your kind help in advance.

Yours sincerely,

Dr. Robert E. Mann,
Senior Scientist,
Clinical, Social and Evaluation Research.

Survey Mailed to ICADTS Members

Assessing the Potential Impact of Lowering the Legal BAL to 50 mg% in Canada.

Investigators: Robert Mann, Scott Macdonald, Susan Bondy and Gina Stoduto, Clinical, Social and Evaluation Research, Addiction Research Foundation, 33 Russell Street, Toronto, Ontario M5S 2S1 Canada.

1. **What is the legal Blood Alcohol Limit (BAL) in your country, i.e., the level at which criminal sanctions can be applied? If the legal BAL varies across the country, we would be grateful if you could provide this information for each of the states or provinces or provide a reference on where this information could be obtained.**
   Example: Canada's criminal code *per se* limit is 80 mg%.

2. **What is the BAL in your country at which administrative sanctions can be assigned? (By administrative sanction, we mean a measure which does not require a criminal conviction to be applied.)**
   Example: In the province of Ontario, administrative sanctions, under the Highway Traffic Act, begin when the Blood Alcohol Level is greater than 50 mg%. At that level, a driver's licence can be suspended for 12 hours at the roadside. Also, under Ontario's Graduated Licence system, drivers with a Graduated Licence can loose their licence for a month if they are caught driving with any alcohol in their blood.

3. **Please list any available reports which you know of that evaluate the impact of a 50 mg% BAL, or of lowering the legal BAL, on collisions and rates of impaired-driving. As well, we are very interested in the impact on those who are driving at levels greater than 150 mg%. Any information you can provide on how to obtain these reports (including copies of the reports if they are available) would be most appreciated.**

4. **Do you know of any reports which evaluate the collision risks associated with driving after drinking, in particular at Blood Alcohol Levels between 50 and 100 mg%? (Please list.)**